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WATER QUALITY AND TIME OF TRAVEL INVESTIGATIONS IN THE LOWER KANSAS RIVER BASIN

J. Lee Mayes, et al

Kansas State Department of Health
Topeka, Kansas

August 1967

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KANSAS STATE DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH SERVICES

Topeka, Kansas
August 1967

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION

142

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General Publications

K13 Water Quality and Time of Travel Investigations in the Lower Kansas River Basin.

By J. Lee Mayes, Chief Engr. and Director
Gerald A. Stoltenberg, Sanitary Engineer
Howard A. Stoltenberg, Chief Chemist

Sponsored by FWPCA, Missouri Basin Region
Kansas State Dept. of Health Topeka, Ks.

Aug 1967

WATER QUALITY AND TIME OF TRAVEL INVESTIGATIONS IN THE LOWER KANSAS RIVER BASIN

J. Lee Mayes
Chief Engineer and Director

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Sanitary Engineer

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A Field Study Sponsored by the
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
MISSOURI BASIN REGION

Environmental Health Services
KANSAS STATE DEPARTMENT OF HEALTH
Topeka, Kansas
August 1967

I

INTRODUCTION

The following report presents the results of the work performed under Contract No. WA 66-3 between the Department of Interior, Federal Water Pollution Control Administration and the Kansas State Department of Health, Environmental Health Services. The work includes summer sampling of the Lower Kansas River Basin from June 13, 1966 through August 29, 1966; winter sampling of the Lower Kansas River Basin from September 12, 1966 through May 15, 1967; intensive sampling of the Saline River in July 1966; and dye study information for the Lower Kansas River Basin covering the period March 23, 1966 through July 19, 1967. The data was gathered to provide verification for predicted hydrologic and chemical quality variations incorporated into the mathematical model of the Lower Kansas River Basin developed by the University of Kansas. The data was also used to further define the characteristics of the basin for the purposes of the model.

The time of travel information was collected as part of the basic data needed to determine reaeration constants for the portion of the basin involved, and for other basic considerations in the model.

The study was sponsored by the Kansas City Regional Office of the Federal Water Pollution Control Administration.

REGULAR SAMPLING

Summer Sampling

The summer portion of the sampling program began June 13, 1966 and continued through August 29, 1966. Regular samples were collected weekly from the following 22 sampling sites (the project area is shown on page 3):

K-1 (K0.3) Kansas River at Kansas City, Kansas

K-2 (K20.3) Kansas River at Bonner Springs

W-3 (K41.7 - W0.4) Wakarusa River at Eudora

K-4 (K53.1) Kansas River at Lawrence

K-5 (K64.1) Kansas River at Lecompton

D-6 (K64.7 - D1.8) Delaware River at Perry

K-7 (K84.0) Kansas River at Topeka

K-8 (K129.1) Kansas River at Wamego

B-9 (K147.1 - B7.3) Big Blue River at Tuttle Creek Dam

K-10 (K148.3) Kansas River at Manhattan

R-11 (K170.4 - R6.0) Republican River at Milford Dam

SH-12 (K170.4 - SH2.0) Smoky Hill River at Junction City

SH-13 (K170.4 - SH43.3) Smoky Hill River at Enterprise

SH-14 (K170.4 - SH83.7) Smoky Hill River at New Cambria

SA-15 (K170.4 - SH89.6 - SA2.0) Saline River at New Cambria

SO-16 (K170.4 - SH68.3 - SO16.9) Solomon River at Niles

SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4) Salt Creek at Minneapolis

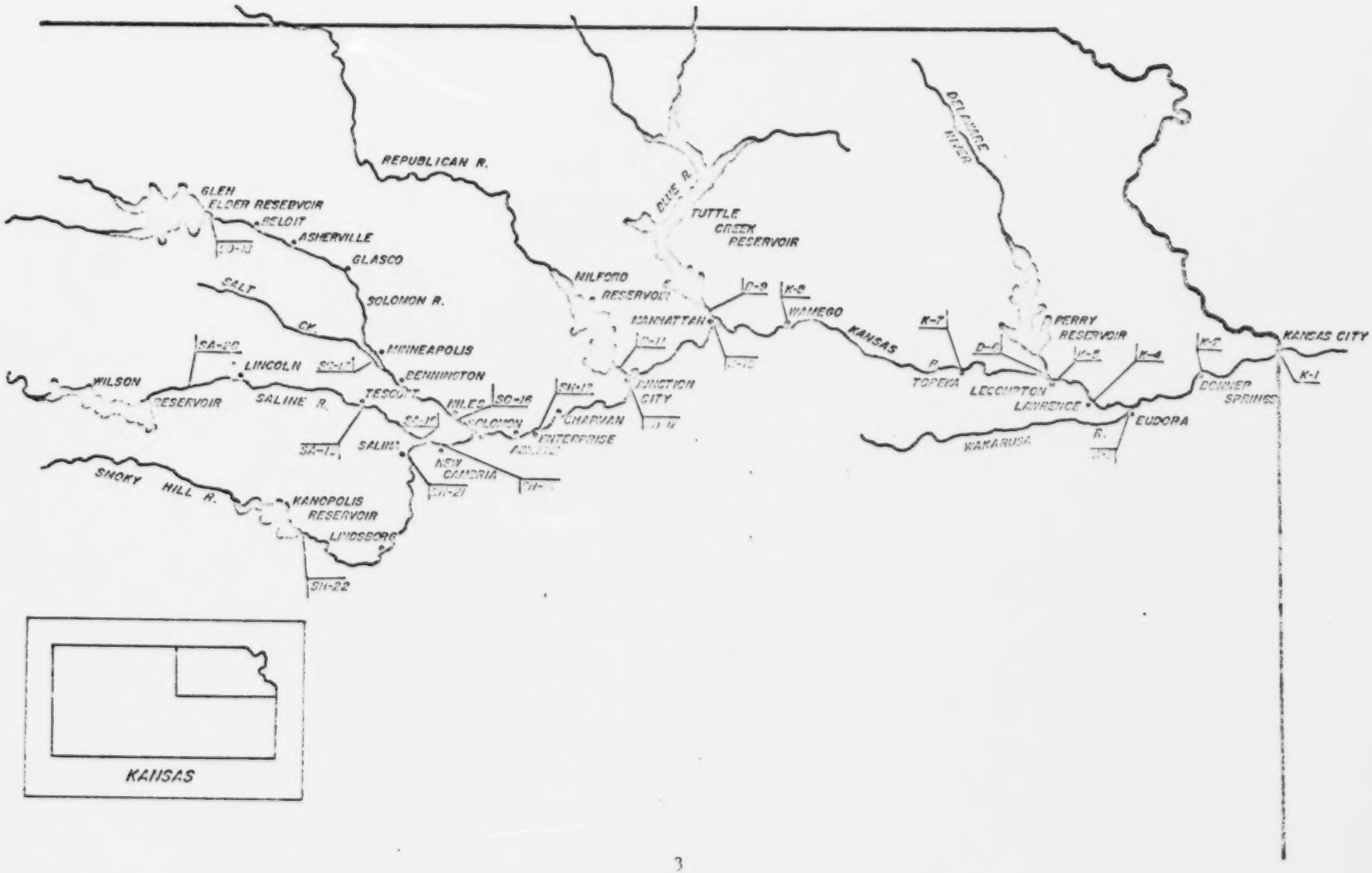
SO-18 (K170.4 - SH68.3 - SO155.1) Solomon River at Glen Elder Dam

SA-19 (K170.4 - SH89.6 - SA68.5) Saline River at Tescott

SA-20 (K170.4 - SH89.6 - SA113.5) Saline River at Sylvan Grove

SH-21 (K170.4 - SH117.0) Smoky Hill River at Mentor

SH-22 (K170.4 - SH177.0) Smoky Hill River at Kanopolis Dam


REPUBLICAN R.
GLEN ELDER RESERVOIR
BELOIT
ASHERVILLE
GLASCO
SALT
SOLOMON R.
CK.
MINNEAPOLIS
WILSON
RESERVOIR
LINCOLN
SALINE R.
TESCOTT
BENNINGTON
MILES
SALINA
SMOKY HILL R.
KANOPOLIS RESERVOIR
LINDSBORG
NEW CAMBRIA
ENTERPRISE
CHAPMAN
JUNCTION CITY
MANHATTAN
NILFORD RESERVOIR
BIG BLUE R.
TUTTLE CREEK RESERVOIR
DELAWARE RIVER
WAMEGO
KANSAS R.
TOPEKA
LECOMPTON
PERRY RESERVOIR
LAWRENCE
WAKARUSA R.
EUDORA
DOWNER SPRINGS
KANSAS CITY
KANSAS

Environmental Health Services of the Kansas State Department of Health provided measurements of the following physical, chemical, and biochemical parameters for the initial samples:

(1) Temperature

(2) pH

(3) Specific Conductance

(4) Chemical Oxygen Demand

(5) Dissolved Oxygen at time of collection

(6) Dissolved Oxygen at start of incubation

(7) Dissolved Oxygen after 3 days in 20°C light box

(8) Dissolved Oxygen after 6 days in 20°C light box

(9) 3 day 20°C dark box BOD

(10) 6 day 20°C dark box BOD

Following analysis of the first 4 weeks of data, it was decided that the light box incubation of the samples beyond 1 day was not yielding worthwhile data. The testing schedule was therefore modified to include the following analyses:

(1) Temperature

(2) pH

(3) Specific Conductance

(4) Chemical Oxygen Demand

(5) Dissolved Oxygen at time of collection

(6) Dissolved Oxygen at start of incubation

(7) Dissolved Oxygen after 1 day in 20°C light box

(8) 1 day 20°C dark box BOD

(9) 3 day 20°C dark box BOD

(10) 6 day 20°C dark box BOD

The 22 samples were collected simultaneously on Monday of each week. Temperature was measured at the time of collection and DO samples were fixed immediately in accordance with the Azide Modification of the Winkler Procedure. Samples were delivered to the Sanitary Engineering Laboratory of Kansas State Department of Health in Topeka on Monday and the remaining determinations were started on Tuesday. Duplicate samples were delivered each Monday to the Kansas Geological Survey at Lawrence for inorganic analysis; and at requested intervals to the F.W.P.C.A., Kansas City, Missouri, Regional Office, for plankton counts.

Dissolved oxygen samples were taken in a standard DO sampler which introduces the water into the bottle from the bottom and displaces its volume 3 times to eliminate air bubbles. The other sample bottles were filled from the remaining sampling bucket volume. BOD and nitrate samples were iced for preservation immediately after collection. All laboratory tests were conducted in accordance with the procedures described in Standard Methods for the Examination of Water and Waste Water.

Winter Sampling

The winter sampling program began September 12, 1966 and continued through May 15, 1967. Samples were taken twice a month at the following 10 stations:

K-2 Kansas River at Bonner Springs

K-5 Kansas River at Lecompton

K-7 Kansas River at Topeka

K-8 Kansas River at Wamego

B-9 Big Blue River at Tuttle Creek Dam

R-11 Republican River at Milford Dam

SH-13 Smoky Hill River at Enterprise

SO-18 Solomon River at Glen Elder Dam

SA-20 Saline River at Sylvan Grove

SH-22 Smoky Hill River at Kanopolis Dam

All laboratory and sampling procedures remained the same throughout the study. During periods of ice cover, samples were obtained through access holes chopped as near as possible to the center of main flow. The station data for the summer and winter portions, arranged chronologically by collection date, is presented on the following pages. Corresponding discharge figures are presented in Table II in the Appendix.

THE KANSAS STATE DEPARTMENT OF HEALTH
July 1, 1966

Kansas River Survey
1st run coll 6-13-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance (if not measured in field)
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 3 days in light box at 20°C
Column (8) - Dissolved Oxygen, mg/l, after 6 days in light box at 20°C
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10
K-1 (K0.3)	20	7.7	320	170	6.6	6.7	4.3	4.0	4.6	9.0
K-2 (K20.3)	22	7.7	400	295	6.4	7.4	6.0	9.5	4.7	6.2
W-3 (K41.7 - WO.4)	20	7.7	170	405	6.1	7.1	3.9	3.3	3.8	5.3
K-4 (K53.1)	20	7.8	160	385	6.1	6.8	4.5	4.8	3.5	5.1
K-5 (K64.1)	20	7.7	150	340	6.5	7.7	5.7	7.3	3.0	5.2
D-6 (K64.7 - D1.8)	21	7.6	150	425	7.3	7.8	6.2	4.6	3.3	5.0
K-7 (K84.0)	22	7.9	540	125	7.0	7.3	14.5	18.5	4.7	8.4
K-8 (K129.1)	23	8.3	2000	65	6.1	7.0	13.4	12.5	3.0	4.8
B-9 (K147.1 - B7.3)	22	8.4	450	40	6.9	7.3	8.2	7.6	0.8	1.3
K-10 (K148.3)	24	8.2	1000	80	7.5	7.1	13.6	22.7	4.7	9.7
R-11 (K170.4 - R6.0)	25	8.2	800	50	7.7	7.4	13.6	15.6	1.3	2.3
SH-12 (K170.4 - SH2.0)	24	8.1	950	65	6.4	6.9	13.6	13.3	2.8	4.9
SH-13 (K170.4 - SH43.3)	26	8.0	1100	55	5.6	7.3	12.3	25.0	1.4	2.8
SH-14 (K170.4 - SH83.7)	26.6	7.9	950	75	6.8	6.4	9.4	20.3	3.1	4.5
SH-21 (K170.4 - SH117.0)	24.4	8.0	825	60	6.9	7.5	10.2	10.3	1.9	3.3
SH-22 (K170.4 - SH177.0)	23.3	8.2	850	20	8.4	7.9	7.6	6.9	1.4	1.9
SA-15 (K170.4 - SH89.6 - SA2.0)	26.6	8.0	2000	75	6.6	6.8	13.7	17.5	3.7	5.6
SA-19 (K170.4 - SH89.6 - SA68.5	26.6	7.7	700	60	3.9	4.7	9.8	19.1	5.7	7.5
SA-20 (K170.4 - SH89.6 - SA113.5)	26.1	8.1	3400	80	8.8	7.8	16.6	15.8	2.9	4.9
SO-16 (K170.4 - SH68.3 - SO16.9	26	8.2	2100	80	5.1	7.3	16.5	20.1	2.9	4.6
SO-18 (K170.4 - SH68.3 - SO155.1)	26	8.1	800	75	6.6	7.4	19.2	26.5	2.6	4.9
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	25	8.2	5000	99	6.3	7.3	30.0	22.4	4.5	7.5

THE KANSAS STATE DEPARTMENT OF HEALTH
July 11, 1966

Kansas River Survey
2nd run coll 6-20-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance (if not measured in field)
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 3 days in light box at 20°C
Column (8) - Dissolved Oxygen, mg/l, after 6 days in light box at 20°C
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	26	8.3	650	65	7.6	8.8	10.8	12.5	3.9	5.8
K-2 (K20.3)	26	8.9	600	80	12.7	11.1	18.1	25.3	5.7	9.5
W-3 (K41.7 - W0.4)	26	8.2	410	50	8.1	8.8	10.1	14.6	1.7	2.8
K-4 (K53.1)	27	8.8	725	70	12.7	9.9	16.5	21.5	6.0	10.5
K-5 (K64.1)	27	8.2	590	60	8.1	8.5	9.2	18.8	3.7	5.8
D-6 (K64.7 - D1.8)	25	8.1	480	55	7.5	8.5	7.7	8.2	1.6	1.9
K-7 (K84.0)	29	8.6	850	115	8.6	8.4	12.8	14.1	3.8	6.4
K-8 (K129.1)	27	8.5	1100	85	8.7	8.2	16.4	19.2	3.5	6.0
B-9 (K147.1 - B7.3)	22	8.2	360	70	5.8	8.1	12.6	22.3	1.3	2.0
K-10 (K148.3)	26	8.2	1200	80	7.5	7.6	14.1	20.5	4.1	6.0
R-11 (K170.4 - R6.0)	22	8.2	700	80	6.3	7.0	17.5	22.7	2.6	4.3
SH-12 (K170.4 - SH2.0	22	8.1	1200	80	6.9	7.3	10.1	18.0	1.5	2.4
SH-13 (K170.4 - SH43.3)	23	8.0	1100	90	7.3	7.1	9.5	16.8	1.5	2.5
SH-14 (K170.4 - SH83.7)	26.6	7.6	1000	60	7.2	4.2	0.3	1.0	4.0	8.0
SH-21 (K170.4 - SH117.0)	23	7.6	800	45	7.0	5.0	2.8	0.6	4.1	5.8
SH-22 (K170.4 - SH177.0)	25	8.0	740	15	8.0	7.1	6.6	7.7	1.4	1.7
SA-15 (K170.4 - SH89.6 - SA2.0)	26.6	8.0	1800	50	6.0	5.9	11.6	12.2	4.6	6.5
SA-19 (K170.4 - SH89.6 - SA68.5)	27.2	7.8	1800	70	7.7	4.7	16.2	12.4	12.0	16.0
SA-20 (K170.4 - SH89.6 - SA113.5)	25.5	7.9	2800	45	6.8	5.8	13.2	19.2	4.1	5.8
SO-16 (K170.4 - SH68.3 - SO16.9)	24	8.2	1200	40	5.9	7.3	17.2	19.7	3.6	5.9
SO-18 (K170.4 - SH68.3 - SO155.1)	28	8.4	1000	69	8.8	7.9	28.7	32.5	3.1	4.8
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	30	8.4	4000	20	8.6	7.2	27.7	26.0	5.8	9.8

THE KANSAS STATE DEPARTMENT OF HEALTH
July 11, 1966

Kansas River Survey
3rd run coll 6-27-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance (if not measured in field)
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 3 days in light box at 20°C
Column (8) - Dissolved Oxygen, mg/l, after 6 days in light box at 20°C
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	26	8.4	790	46	5.8	7.8	16.2	20.2	4.7	10.0
K-2 (K20.3)	25	7.8	340	173	5.8	7.5	6.7	9.4	2.5	4.9
W-3 (K41.7 - W0.4)	23	7.7	230	131	4.4	6.7	5.0	8.1	2.6	4.6
K-4 (K53.1)	24	7.7	250	233	5.3	7.5	5.0	5.9	2.7	5.0
K-5 (K64.1)	24	7.6	210	233	5.6	7.8	4.7	5.7	2.6	4.2
D-6 K64.7 - D1.8)	23	7.7	220	224	5.4	7.7	6.3	8.9	2.3	4.1
K-7 (K84.0)	26	8.6	790	40	9.0	8.6	12.0	12.5	2.7	4.6
K-8 (K129.1)	27	8.8	900	41	9.3	7.0	11.6	15.3	3.6	5.4
B-9 (K147.1 - B7.3)	23	8.3	440	16	7.1	7.7	8.0	11.2	1.2	2.0
K-10 (K148.3)	27	8.6	1100	36	8.5	6.9	10.8	12.7	2.6	4.3
R-11 (K170.4 - R6.0)	24	8.4	900	34	4.4	7.0	14.4	19.1	3.1	4.9
SH-12 (K170.4 - SH2.0)	24	8.3	1300	29	4.4	7.4	18.3	24.2	1.8	2.7
SH-13 (K170.4 - SH43.3)	27	8.4	1800	28	9.7	7.8	18.6	22.2	1.7	3.0
SH-14 (K170.4 - SH83.7)	25.5	7.8	1075	33	7.9	1.0	0.0	0.0	17.	----
SH-21 (K170.4 - SH117.0)	25.0	8.3	1000	25	6.8	6.4	9.4	7.9	2.7	4.4
SH-22 (K170.4 - SH177.0)	23.3	8.0	940	19	7.7	6.0	6.2	11.9	2.8	3.6
SA-15 (K170.4 - SH89.6 - SA2.0)	25.5	7.9	1700	38	3.6	5.9	20.6	22.4	3.1	5.2
SA-19 (K170.4 - SH89.6 - SA68.5)	26.6	7.7	2950	43	3.4	3.7	14.6	15.3	6.0	11.0
SA-20 (K170.4 - SH89.6 - SA113.5)	23.3	7.8	3500	36	3.8	6.3	16.5	19.9	3.2	5.1
SO-16 (K170.4 - SH68.3 - SO16.9)	28	8.3	1600	33	8.0	6.4	12.9	15.6	3.6	5.5
SO-18 (K170.4 - SH68.3 - SO155.1)	24	7.8	360	224	6.1	6.7	12.2	28.3	2.5	4.6
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	28	8.3	4000	75	12.5	6.1	23.5	22.2	8.2	15.0

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
4th run coll 7-5-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance (if not measured in field)
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 3 days in light box at 20°C
Column (8) - Dissolved Oxygen, mg/l, after 6 days in light box at 20°C
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	30	7.7	680	42	0.3	7.9	7.0	6.5	2.3	4.7
K-2 (K20.3)	30	8.7	820	45	7.7	8.8	8.4	9.7	6.2	10.
W-3 (K41.7 - W0.4)	30	8.3	450	31	9.5	9.3	11.7	14.6	2.8	4.9
K-4 (K53.1)	31	8.4	770	38	5.8	7.8	10.9	14.3	5.0	8.3
K-5 (K64.1)	31	8.4	650	40	10.4	9.1	13.9	17.0	5.0	9.0
D-6 (K64.7 - D1.8)	31	8.5	550	26	13.1	10.4	9.5	8.7	3.3	6.3
K-7 (K84.0)	31	8.5	660	48	9.3	8.1	14.9	20.5	7.2	13.
K-8 (K129.1)	30	8.8	780	35	11.3	8.3	26.5	24.2	5.0	8.0
B-9 (K147.1 - B7.3)	25	8.1	440	18	7.8	7.9	10.7	26.2	0.6	1.0
K-10 (K148.3)	33	8.6	1200	43	8.3	7.7	19.1	26.7	4.8	7.5
R-11 (K170.4 - R6.0)	30	8.2	440	29	6.9	7.4	13.1	25.7	1.1	1.7
SH-12 (K170.4 - SH2.0)	29	8.3	1950	35	6.9	7.1	12.4	14.7	2.6	4.6
SH-13 (K170.4 - SH43.3)	29	8.3	1880	29	6.4	7.5	19.2	20.9	2.8	4.8
SH-14 (K170.4 - SH83.7)	31.1	8.7	1100	31	14.7	11.0	23.8	30.9	5.6	8.8
SH-21 (K170.4 - SH117.0)	26.1	8.1	950	21	6.3	7.1	10.5	11.6	3.1	5.5
SH-22 (K170.4 - SH177.0)	24.4	8.1	900	15	8.1	8.4	6.3	7.2	3.0	4.1
SA-15 (K170.4 - SH89.6 - SA2.0)	30.0	8.0	1480	37	4.6	6.4	13.5	19.2	3.6	6.7
SA-19 (K170.4 - SH89.6 - SA68.5)	29.4	8.0	4170	54	4.7	6.6	20.5	21.8	9.5	14.
SA-20 (K170.4 - SH89.6 - SA113.5)	27.2	7.9	3400	33	5.9	7.0	22.3	24.4	2.6	4.6
SO-16 (K170.4 - SH68.3 - SO16.9)	28	8.2	790	33	6.0	7.5	23.2	32.0	1.9	3.2
SO-18 (K170.4 - SH68.3 - SO155.1)	24	8.0	1370	28	4.8	6.8	20.5	19.7	3.2	4.9
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	25	8.0	3910	74	3.1	5.4	31.7	29.1	10.	17.

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
5th run coll 7-11-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)*	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	30	8.2	530	27	3.4	7.6	8.6	0.5	2.1	3.4
K-2 (K20.3)	29	8.2	570	35	6.0	8.5	9.7	0.8	1.8	3.7
W-3 (K41.7 - W0.4)	30	7.9	325	32	4.3	7.7	7.9	0.2	0.4	0.8
K-4 (K53.1)	30	8.1	700	36	5.2	8.3	10.0	1.2	2.7	4.6
K-5 (K64.1)	31	8.2	520	36	7.7	8.6	10.4	1.6	2.4	4.7
D-6 (K64.7 - D1.8)	31	8.0	400	22	6.8	8.4	8.8	0.3	0.8	1.6
K-7 (K84.0)	31	8.4	660	33	7.4	7.8	9.5	1.3	3.7	6.7
K-8 (K129.1)	30	8.6	650	30	9.3	8.3	15.2	0.8	2.6	4.6
B-9 (K147.1 - B7.3	28	8.1	420	22	7.8	8.1	8.1	0.2	0.3	0.4
K-10 (K148.3)	32	8.6	800	34	8.0	7.8	11.1	1.1	3.1	5.1
R-11 (K170.4 - R6.0)	31	8.5	520	28	7.3	7.4	10.7	0.5	1.3	1.9
SH-12 (K170.4 - SH2.0)	32	8.3	1800	28	7.5	7.5	9.5	0.3	2.0	4.1
SH-13 (K170.4 - SH43.3)	32	8.5	3000	38	11.3	8.0	9.7	0.3	3.1	5.2
SH-14 (K170.4 - SH83.7)	31.1	9.0	1400	35	17.1	10.2	18.6	0.8	4.9	8.4
SH-21 (K170.4 - SH117.0)	26.1	8.2	975	24	6.9	7.8	8.5	0.6	1.9	3.1
SH-22 (K170.4 - SH177.0)	26.1	8.2	925	13	8.1	8.1	7.2	1.0	1.4	2.2
SA-15 (K170.4 - SH89.6 - SA2.0)	30.0	8.1	3000	37	5.7	7.2	12.3	2.1	4.0	6.2
SA-19 (K170.4 - SH89.6 - SA68.5)	28.3	7.9	3800	46	4.7	4.8	7.6	2.3	8.5	12.
SA-20 (K170.4 - SH89.6 - SA113.5)	27.2	7.9	3700	33	8.0	6.0	6.4	2.1	4.6	7.8
SO-16 (K170.4 - SH68.3 - SO16.9)	32	8.2	1100	30	7.3	7.0	11.1	1.1	3.4	5.4
SO-18 (K170.4 - SH68.3 - SO155.1)	28	8.0	560	122	6.0	7.0	7.4	1.0	2.8	4.2
SC-17 (K170.4 - SH68.3 - SC45.9 - SC10.4)	29	8.0	4000	83	5.6	5.1	20.2	3.9	11.	17.

*Data for specific conductance obtained by field measurement

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Sanitary Engineering Laboratory

Kansas River Survey
6th run coll 7-18-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)*	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	29	7.9	685	35	4.4	7.1	8.6	1.1	3.4	5.1
K-2 (K20.3)	29	8.5	580	39	8.7	8.8	11.9	1.7	3.8	6.6
W-3 (K41.7 - W0.4)	30	8.6	375	48	13.4	10.2	16.7	2.1	4.5	8.0
K-4 (K53.1)	32	8.7	600	41	10.0	8.7	10.2	3.6	7.3	11.
K-5 (K64.1)	32	8.3	615	41	10.4	9.1	10.3	3.0	5.8	9.5
D-6 (K64.7 - D1.8)	32	8.2	580	23	9.5	9.1	9.2	1.2	2.6	4.0
K-7 (K84.0)	33	8.5	650	38	9.7	8.3	9.2	2.4	5.5	8.8
K-8 (K129.1)	26	8.2	800	27	6.3	6.2	11.9	0.9	2.7	5.0
B-9 (K147.1 - B7.3)	24	8.0	460	23	7.2	7.0	8.2	0.6	1.2	2.0
K-10 (K148.3)	27	8.3	950	29	7.8	6.8	11.0	1.4	2.9	4.9
R-11 (K170.4 - R6.0)	28	7.8	560	38	7.6	5.5	13.5	1.9	4.4	---
SH-12 (K170.4 - SH2.0)	30	8.2	2500	28	6.9	6.5	10.3	0.9	2.4	3.7
SH-13 (K170.4 - SH43.3)	32	8.1	4000	32	9.9	7.2	14.1	1.7	4.8	7.0
SH-14 (K170.4 - SH83.7)	28.8	8.3	1750	35	10.4	7.3	16.1	1.4	3.8	6.2
SH-21 (K170.4 - SH117.0)	26.6	8.0	940	25	6.3	5.9	6.7	1.2	2.9	4.3
SH-22 (K170.4 - SH177.0)	27.7	8.0	875	18	7.1	6.1	5.5	1.0	1.8	2.6
SA-15 (K170.4 - SH89.6 - SA2.0)	28.3	7.7	2500	37	3.2	6.1	11.1	1.0	2.4	4.2
SA-19 (K170.4 - SH89.6 - SA68.5)	28.3	7.6	2500	44	4.4	3.9	5.2	3.2	7.5	11.
SA-20 (K170.4 - SH89.6 - SA113.5)	28.3	7.7	2700	21	3.8	5.4	6.0	1.5	3.5	5.1
SO-16 (K170.4 - SH68.3 - SO16.9)	30	8.1	2000	38	7.7	6.6	9.8	1.6	5.5	9.3
SO-18 (K170.4 - SH68.3 - SO155.1)	28	8.0	3000	24	7.1	6.3	11.6	1.4	3.2	5.0
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	29	7.8	5500	101	6.8	5.7	25.6	4.4	12.	20.

*Data for specific conductance obtained by field measurement

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Sanitary Engineering Laboratory

Kansas River Survey
7th run coll 7-25-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)*	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	28	8.5	790	38	4.6	7.7	16.5	3.4	7.1	11.
K-2 (K20.3)	28	8.3	600	58	5.9	8.2	11.3	1.6	3.5	5.9
W-3 (K41.7 - W0.4)	28	8.1	395	30	12.1	9.7	11.6	2.1	4.2	6.6
K-4 (K53.1)	31	8.7	700	29	7.4	8.4	12.1	1.6	4.6	7.6
K-5 (K64.1)	30	8.4	680	38	8.6	8.9	12.8	1.7	4.3	7.4
D-6 (K64.7 - D1.8)	31	8.2	390	19	8.2	8.9	9.9	0.7	2.2	3.6
K-7 (K84.0)	30	8.5	680	30	8.2	8.8	10.8	1.4	3.7	6.2
K-8 (K129.1)	26	8.3	680	23	7.3	7.2	14.4	1.2	2.5	4.2
B-9 (K147.1 - B7.3)	24	7.9	450	14	7.9	7.7	7.8	0.6	1.2	1.7
K-10 (K148.3)	26	8.3	1000	28	8.3	7.2	13.3	1.5	3.0	5.1
R-11 (K170.4 - R6.0	28	8.3	560	24	7.9	7.6	13.2	1.2	3.0	4.7
SH-12 (K170.4 - SH2.0)	28	8.0	3000	23	7.6	7.4	12.1	1.3	3.2	5.1
SH-13 (K170.4 - SH43.3)	28	8.1	5000	28	6.4	6.8	17.5	1.3	3.1	5.2
SH-14 (K170.4 - SH83.7)	27.7	7.9	700	37	5.2	7.4	8.7	0.8	2.2	3.4
SH-21 (K170.4 - SH117.0)	26.6	8.0	675	26	6.6	7.1	7.3	0.7	1.5	2.5
SH-22 (K170.4 - SH177.0)	26.6	8.1	825	15	7.1	7.8	7.9	0.3	1.4	1.7
SA-15 (K170.4 - SH89.6 - SA2.0)	27.2	7.6	810	43	4.5	7.4	8.0	0.7	1.8	3.3
SA-19 (K170.4 - SH89.6 - SA68.5	28.8	8.0	2800	43	4.1	6.6	8.3	3.0	5.5	8.5
SA-20 (K170.4 - SH89.6 - SA113.5)	27.2	7.9	3000	24	3.5	7.0	8.5	0.9	2.2	3.3
SO-16 (K170.4 - SH68.3 - SO16.9)	29	7.7	600	58	5.3	6.8	8.2	0.9	2.5	3.9
SO-18 (K170.4 - SH68.3 - SO155.1)	26	7.9	800	37	7.0	7.4	20.8	2.1	4.8	7.5
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	27	7.6	1200	49	2.7	6.6	13.1	1.4	3.2	5.3

*Data for specific conductance obtained by field measurement.

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Kansas River Survey
8th Run - coll 8-1-66

Column (1) - Station Number
Column (1A)- Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10)- 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	27°C	7.9	840	38	3.9	8.2	8.0	1.7	3.6	5.5
K-2 (K20.3)	28°C	8.0	1040	48	6.9	8.6	11.3	2.5	5.6	8.5
K-3 (K41.7 - W0.4)	27°C	7.8	490	31	7.2	8.0	8.7	1.1	2.3	3.4
K-4 (K53.1)	29°C	8.2	900	43	6.6	8.8	14.7	1.4	3.1	6.0
K-5 (K64.1)	27°C	8.0	660	38	7.4	8.7	10.0	0.8	1.7	2.7
D-6 (K64.7 - D1.8)	28°C	8.1	520	23	7.9	9.3	9.3	0.6	1.1	1.5
K-7 (K84.0)	27°C	8.3	640	39	7.2	8.3	10.8	1.1	2.9	4.7
K-8 (K129.1)	26°C	8.0	580	46	6.7	8.4	10.8	1.8	4.2	6.2
B-9 (K147.1 - B7.3)	27°C	8.0	470	27	11.1	9.2	8.7	2.1	3.3	5.0
K-10 (K148.3)	27°C	7.8	650	51	6.6	8.9	9.2	2.3	4.5	6.4
R-11 (K170.4 - R6.0)	29°C	8.0	490	34	7.1	9.2	9.0	1.5	2.5	3.5
SH-12 (K170.4 - SH2.0)	28°C	7.7	1180	52	5.8	8.9	9.6	1.3	3.4	4.5
SH-13 (K170.4 - SH43.3)	30°C	7.6	900	84	5.4	8.7	6.4	3.1	4.7	6.6
SH-14 (K170.4 - SH83.7)	29°C	7.6	920	45	6.0	8.9	7.8	1.8	3.4	4.9
SH-21 (K170.4 - SH117.0)	28°C	7.7	900	32	6.1	8.9	7.2	2.0	3.4	4.6
SH-22 (K170.4 - SH177.0)	27°C	7.8	810	15	7.1	8.7	7.3	1.4	2.2	2.8
SA-15 (K170.4 - SH89.6 - SA2.0)	29°C	7.7	2060	43	4.5	8.9	12.5	2.4	4.6	6.9
SA-19 (K170.4 - SH89.6 - SA68.5)	29°C	7.8	2410	41	3.8	7.5	11.8	3.3	6.5	9.0
SA-20 (K170.4 - SH89.6 - SA113.5)	28°C	7.8	2960	28	4.0	8.8	9.8	1.8	3.8	6.1
SO-16 (K170.4 - SH68.3 - SO16.9)	29°C	7.7	760	92	5.6	8.9	6.1	3.2	6.0	8.5
SO-18 (K170.4 - SH68.3 - SO155.1)	27°C	8.0	670	50	6.0	8.6	9.2	2.0	4.1	5.8
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	28°C	7.9	950	62	2.0	8.4	6.8	3.0	6.0	8.0

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Kansas River Survey
9th Run - coll 8-8-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	27	7.6	750	43	1.2	7.0	9.2	2.9	6.5	9.0
K-2 (K20.3)	25	8.2	660	35	8.7	8.7	12.7	1.3	2.5	4.1
K-3 (K41.7 - K0.4)	27	7.9	480	35	6.0	8.2	9.2	1.0	1.9	3.2
K-4 (K53.1)	27	7.9	600	32	5.5	7.7	10.4	0.8	1.6	2.6
K-5 (K64.1)	27	8.1	690	50	7.7	8.7	10.3	1.0	2.2	3.9
D-6 (K64.7 - D1.8)	27	8.1	490	26	10.0	9.1	10.0	0.8	1.9	2.8
K-7 (K84.0)	27	8.2	690	52	8.0	8.6	11.5	1.1	2.3	4.0
K-8 (K129.1)	27	8.1	590	53	7.4	8.1	9.6	0.7	2.0	3.2
D-9 (K147.1 - B7.3)	25	8.0	450	27	8.4	8.1	8.5	0.8	1.5	2.6
K-10 (K148.3)	26	8.0	730	51	7.5	7.7	8.3	1.5	2.8	4.9
R-11 (K170.4 - R6.0)	27	8.3	520	36	7.8	8.7	10.5	1.3	2.6	4.2
SH-12 (K170.4 - SH2.0)	27	7.9	780	55	6.4	8.6	6.9	2.5	3.9	6.9
SH-13 (K170.4 - SH43.3)	26	7.8	930	42	6.5	8.4	8.9	0.8	1.9	3.3
SH-14 (K170.4 - SH89.7)	26	7.8	790	25	6.8	8.5	8.6	1.2	2.2	3.0
SH-21 (K170.4 - SH117.0)	26	7.6	770	26	6.8	8.2	7.2	1.4	2.8	3.6
SH-22 (K170.4 - SH177.0)	26	7.7	750	15	7.4	8.7	8.2	1.1	1.7	2.5
SA-15 (K170.4 - SH89.6 - SA2.0)	26	7.9	1200	34	4.8	8.0	12.6	2.0	3.9	5.9
SA-19 (K170.4 - SH89.6 - SA68.5)	24	7.9	2870	46	5.6	8.3	11.7	4.7	8.1	12.
SA-20 (K170.4 - SH89.6 - SA113.5)	18	7.6	1040	163	5.6	7.7	5.7	2.2	3.6	6.8
SO-16 (K170.4 - SH68.3 - SO16.9)	25	7.9	1210	42	7.4	8.6	11.8	3.2	6.2	9.5
SO-18 (K170.4 - SH68.3 - SO155.1)	20	8.0	1930	34	7.5	8.4	11.9	2.5	4.4	7.7
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	21	7.9	1870	41	3.7	6.9	15.0	2.2	4.7	7.0

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Sanitary Engineering Laboratory

Kansas River Survey
10th Run - coll 8-15-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	25	8.0	690	33	5.0	8.8	12.2	1.3	3.1	4.8
K-2 (K20.3)	25	8.5	740	35	8.4	9.1	13.4	1.2	2.7	4.8
K-3 (K41.7 - W0.4)	25	8.0	470	27	8.2	9.1	10.5	1.1	1.9	3.5
K-4 (K53.1)	26	8.4	750	38	9.2	9.6	14.7	1.8	2.9	6.4
K-5 (K64.1)	28	8.4	670	38	9.4	9.2	12.2	1.1	3.4	4.6
D-6 (K64.7 - D1.8)	26	8.5	450	36	12.9	10.3	11.5	0.9	2.2	3.0
K-7 (K84.0)	28	8.4	690	49	9.3	9.2	9.5	4.2	7.2	11.
K-8 (K129.1)	30	8.5	770	42	9.2	8.9	11.4	1.5	3.3	5.8
B-9 (K147.1 - B7.3)	27	8.0	470	21	9.4	9.2	9.2	1.0	1.6	2.4
K-10 (K148.3)	29	8.4	760	32	8.2	9.2	11.3	1.2	2.9	4.6
R-11 (K170.4 - R6.0)	25	8.3	570	36	7.3	9.0	11.3	1.1	2.5	4.2
SH-12 (K170.4 - SH2.0)	25	8.0	870	31	7.0	8.7	9.2	0.7	1.3	2.4
SH-13 (K170.4 - SH43.3)	24	8.0	910	33	6.3	8.7	9.3	0.7	1.3	2.1
SH-14 (K170.4 - SH83.7)	26	8.0	1100	33	6.5	8.8	9.4	1.1	2.3	3.9
SH-21 (K170.4 - SH117.0)	26	8.0	630	53	6.8	9.4	8.4	1.1	2.3	3.2
SH-22 (K170.4 - SH177.0)	24	8.0	760	20	7.4	9.1	8.4	1.1	1.6	2.0
SA-15 (K170.4 - SH89.6 - SA2.0)	26	8.0	2320	35	5.3	8.6	13.6	1.2	2.3	4.1
SA-19 (K170.4 - SH89.6 - SA68.5)	24	8.0	1320	35	5.1	8.3	9.2	1.6	2.7	4.3
SA-20 (K170.4 - SH89.6 - SA113.5)	24	8.0	2630	33	5.2	8.6	8.1	1.7	2.8	3.7
SO-16 (K170.4 - SH68.3 - SO16.9)	22	8.2	1240	24	6.6	8.1	11.4	1.3	2.6	4.2
SO-18 (K170.4 - SH68.3 - SO155.1)	24	8.2	770	33	7.6	8.6	18.2	1.7	3.1	5.4
SC-17 (K170.4 - SH68.3 - SO45.9 - SC10.4)	26	8.0	2150	44	3.9	7.2	11.1	2.2	3.8	7.0

HAS:lj

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Kaws River Survey
11th Run - coll 8-22-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	25	8.0	520.	41	4.3	7.7	8.1	1.3	2.5	4.1
K-2 (K20.3)	25	8.2	600.	47	8.6	9.7	11.4	1.3	3.0	5.1
K-3 (K41.7 - W0.4)	24	8.0	270.	42	4.4	7.2	7.1	0.6	1.3	2.4
K-4 (K53.1)	24	8.4	600.	40	8.1	8.8	12.2	1.1	2.3	3.7
K-5 (K64.1)	24	7.9	380.	36	7.0	8.5	8.7	0.3	1.0	1.8
D-6 (K64.7 - D1.8)	23	8.0	400.	41	7.7	8.8	8.8	0.7	1.3	2.4
K-7 (K84.0)	24	8.3	520.	69	7.0	8.2	8.6	1.2	2.4	3.8
K-8 (K129.1)	24	8.3	620.	46	6.8	8.5	8.8	1.6	2.9	4.8
D-9 (K147.1 - D7.3)	23	8.2	450.	25	7.5	9.5	9.0	0.6	1.3	1.8
K-10 (K148.3)	22	8.4	890.	36	7.4	8.8	10.0	0.7	2.0	3.1
R-11 (K170.4 - R6.0)	22	8.3	450.	42	7.1	8.7	10.8	0.8	2.1	3.3
SH-12 (K170.4 - SH2.0)	23	8.2	1290.	36	7.2	8.7	10.7	0.5	1.3	2.3
SH-13 (K170.4 - SH43.3)	22	7.9	320.	359	5.0	6.8	4.5	1.5	3.2	5.5
SH-14 (K170.4 - SH83.7)	22	7.9	260.	217	4.4	7.5	5.4	1.7	2.7	3.8
SH-21 (K170.4 - SH117.0)	23	7.9	740.	25	7.2	9.3	8.3	1.0	2.0	2.7
SH-22 (K170.4 - SH177.0)	24	8.0	750.	14	7.6	9.0	9.2	0.2	1.3	1.9
SA-15 (K170.4 - SH89.6 - SA2.0)	21	8.0	160.	293	4.4	7.1	4.7	2.0	3.2	4.6
SA-19 (K170.4 - SH89.6 - SA68.5)	21	7.7	450.	189	5.7	7.6	5.4	2.1	4.1	6.0
SA-20 (K170.4 - SH89.6 - SA113.5)	21	7.7	640.	274	5.0	6.6	4.6	1.3	2.3	4.3
SO-16 (K170.4 - SH68.3 - SO16.9)	21	8.0	180.	312	4.0	6.9	4.1	2.0	3.6	5.5
SO-18 (K170.4 - SH68.3 - SO155.1)	20	7.9	250.	159	5.2	7.4	5.5	1.7	3.0	5.3
SO-17 (K170.4 - SH68.3 - SO45.9 - SO10.4)	20	7.9	240.	145	5.3	6.8	4.5	1.8	3.4	4.4

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Kansas River Survey
12th Run - coll 8-29-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-1 (K0.3)	25	8.3	370	60	5.1	7.4	6.9	0.8	1.9	2.9
K-2 (K20.3)	25	8.4	360	98	7.1	8.7	8.5	0.5	1.1	2.2
K-3 (K41.7 - W0.4)	25	8.5	310	36	10.2	9.5	12.9	2.5	5.3	9.1
K-4 (K53.1)	26	8.3	370	38	6.7	8.6	8.5	0.4	0.7	1.4
K-5 (K64.1)	26	8.4	390	87	7.1	8.7	8.4	0.5	1.2	2.4
K-6 (K64.7 - D1.8)	29	8.9	370	34	17.6	12.2	13.1	1.1	3.4	6.0
K-7 (K84.0)	27	8.5	420	76	7.1	8.3	7.4	1.2	2.2	3.7
K-8 (K129.1)	27	8.4	450	120	6.5	7.5	6.2	1.4	2.7	3.8
K-9 (K174.1 - B7.3)	26	8.4	520	27	10.2	9.5	10.2	1.4	3.7	5.5
K-10 (K148.3)	26	8.3	480	90	6.8	8.1	7.9	0.7	1.7	2.5
K-11 (K170.4 - R6.0)	24	8.4	470	38	7.7	8.4	9.0	0.9	1.7	3.1
SH-12 (K170.4 - SH2.0)	23	8.3	420	175	6.8	8.4	7.2	0.7	1.6	3.9
SH-13 (K170.4 - SH43.3)	23	8.3	580	93	6.7	8.4	8.1	0.4	2.1	3.3
SH-14 (K170.4 - SH83.7)	25	8.6	940	26	6.8	8.1	8.6	1.7	3.0	4.0
SH-21 (K170.4 - SH117.0)	24	8.3	700	22	7.4	8.3	8.5	1.0	1.8	2.6
SH-22 (K170.4 - SH177.0)	24	8.3	710	14	8.0	8.6	8.2	0.7	1.3	2.0
SA-15 (K170.4 - SH89.6 - SA2.0)	25	8.3	1240	48	5.9	7.7	7.1	1.7	2.9	4.8
SA-19 (K170.4 - SH89.6 - SA68.5)	24	8.2	1090	31	5.2	7.1	7.0	1.4	2.7	4.1
SA-20 (K170.4 - SH89.6 - SA113.5)	23	8.3	2730	25	5.8	7.6	9.3	1.8	3.0	4.1
SC-16 (K170.4 - SH68.3 - SC16.9)	22	8.4	340	73	6.5	8.1	7.4	0.8	1.8	3.3
SC-18 (K170.4 - SH68.3 - SC155.1)	22	8.5	880	28	6.9	8.2	14.1	1.2	2.4	4.1
SC-17 (K170.4 - SH68.3 - SC45.9 - SC10.4)	23	8.2	1530	45	4.0	6.4	11.0	1.9	3.9	7.5

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Kansas River Survey
1st Limited Run - Coll 9-12-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	24	8.1	460	34	7.1	8.0	8.8	0.3	1.8	2.7
K-4 (53.1)	24	8.1	510	39	7.0	7.6	8.8	0.5	2.3	3.8
K-7 (K84.0)	22	8.3	650	45	7.5	8.3	8.6	1.2	2.5	4.0
K-8 (K129.1)	23	8.1	540	38	7.5	8.7	8.7	0.7	1.4	2.7
B-9 (K147.1 - B7.3)	23	8.1	430	8.0	8.3	9.0	8.8	0.4	0.7	1.1
K 10 (K148.3)	24	8.1	550	57	7.6	8.6	9.4	0.6	1.2	2.1
R-11 (K170.4 - R6.0)	23	8.2	460	30	7.7	8.6	11.3	0.6	1.3	2.3
SO-18 (K170.4 - SM68.3 - SO155.1)	21	8.4	930	29	7.6	8.2	25.4*	---	2.8	4.8
SA-20 (K170.4 - SM89.6 - SA113.5)	21	8.1	2700	34	6.3	7.2	14.1*	---	2.8	4.3
SM-22 (K170.4 - SM177.0)	23	8.2	750	13	8.0	8.2	8.0*	---	0.9	1.5

* Dissolved oxygen after 3 days incubation in light box. One day BOD not determined because of limited sample.

WAS:lj

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Kansas River Survey
2nd Limited Run - Coll 9-19-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	18	8.2	560	32	8.5	9.3	9.7	0.7	1.9	3.1
K-4 (K53.1)	19	8.2	560	21	8.1	9.2	9.9	0.2	1.0	2.0
K-7 (K84.0)	18	8.2	570	27	8.4	9.3	9.2	1.3	2.7	3.6
K-8 (K129.1)	19	8.2	560	19	8.2	9.7	10.0	0.6	1.3	2.0
R-9 (K147.1 - R7.3)	21	8.1	430	12	8.3	9.5	9.3	0.3	0.7	1.0
K-10 (K148.3)	18	8.1	850	44	8.5	10.0	17.3	1.0	2.4	4.1
R-11 (K170.4 - R6.0)	19	8.0	400	34	9.0	9.5	13.4	0.8	1.8	3.1
SO-18 (K170.4 - SH68.3 - SO155.1)	18	8.1	820	26	9.1	9.1	9.5	1.3	2.6	3.7
SA-20 (K170.4 - SH89.6 - SA113.5)	18	8.1	2780	26	8.6	9.1	9.4	1.7	3.3	4.3
SH-22 (K170.4 - SH177.0)	21	8.0	720	16	8.0	8.8	8.1	0.9	2.0	2.8

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Kansas River Survey
3rd Limited Run - coll 10-3-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	19	8.5	600	36	9.7	9.0	12.9	1.3	2.7	5.1
K-4 (K53.1)	18	8.4	610	46	9.7	9.5	13.4	1.4	2.3	4.1
K-7 (K84.0)	17	8.5	620	30	9.4	9.0	11.8	1.6	3.1	5.2
K-8 (K129.4)	--	8.5	630	27	9.8	9.8	10.2	1.4	2.8	4.2
K-9 (K147.1 - R7.3)	18	8.2	470	20	9.1	8.9	7.1	2.0	3.0	3.8
K-10 (K148.3)	17	8.5	1170	41	10.9	9.4	16.2	3.9	6.7	10.
K-11 (K170.4 - R6.0)	18	8.2	710	47	9.0	8.1	12.9	2.8	4.9	7.2
SO-18 (K170.4 - SK68.3 - SO155.1)	15	8.2	1100	17	7.9	8.7	8.7	1.7	2.9	3.6
SA-20 (K170.4 - SK89.6 - SA113.5)	16	8.2	3030	24	7.1	8.5	10.0	1.7	2.9	3.7
SK-22 (K170.4 - SK177.0)	17	8.1	770	17	8.4	8.7	8.1	0.9	1.8	2.5

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Kansas River Survey
4th Limited Run - coll 10-17-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-4 (K20.3)	12	8.3	560	28	10.9	9.8	11.1	1.1	2.2	3.9
K-5 (K64.1)	10	8.3	600	30	9.9	9.9	11.7	1.1	2.7	3.8
K-7 (K84.0)	10	8.3	570	20	10.0	9.8	9.9	1.5	2.3	3.4
K-8 (K129.1)	15	8.2	590	15	9.4	10.2	10.2	0.9	1.1	1.6
K-9 (K147.1 - B7.3)	15	8.2	440	16	9.1	9.9	9.9	0.9	1.3	1.7
K-11 (K170.4 - R6.0)	14	8.4	730	19	10.0	10.0	13.6	1.3	2.3	3.4
SK-13 (K170.4 - SK43.3)	15	8.1	930	31	9.3	9.5	12.9	1.1	2.1	3.4
SO-18 (K170.4 - SK68.3 - SO155.1)	7	8.1	1210	17	9.5	9.8	9.9	1.6	2.6	3.5
SA-20 (K170.4 - SK89.6 - SA113.5)	8	8.2	2360	18	9.5	9.5	9.3	0.9	1.8	2.3
SK-22 (K170.4 - SK177.0)	14	8.3	760	26	9.6	9.7	9.1	0.8	1.5	2.0

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Kansas River Survey
5th Limited Run - coll 10-31-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/1
Column (5) - Dissolved Oxygen, mg/1, at time of collection
Column (6) - Dissolved Oxygen, mg/1, when incubation started
Column (7) - Dissolved Oxygen, mg/1, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/1, dark box
Column (9) - 3 day 20°C BOD, mg/1, dark box
Column (10) - 6 day 20°C BOD, mg/1, dark box
Column (11) - Nitrate (as NO_3) in mg/1

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
K-2 (K20.3)	10	8.6	830	29	11.4	10.5	20.5	2.4	5.4	8.1	2.7
K-5 (K64.1)	11	8.3	930	30	11.7	10.6	19.2	2.5	5.9	8.9	1.5
K-7 (K84.0)	11	8.5	850	34	10.4	9.7	17.6	1.7	4.7	7.8	1.8
K-8 (K129.1)	12	8.3	610	15	9.3	10.1	18.6	0.9	2.0	3.2	2.7
B-9 (K147.1 - B7.3)	12	8.3	410	7.6	9.6	10.1	10.4	0.1	0.4	0.6	2.2
R-11 (K170.4 - R6.0)	10	8.4	700	13	9.9	10.2	15.9	0.9	2.3	3.6	1.8
SH-13 (K170.4 - SH43.3)	12	8.4	2430	17	9.8	9.8	14.6	0.4	1.8	3.1	2.2
SO-18 (K170.4 - SH68.3 - SO155.1)	9	8.1	1140	15	8.4	9.0	9.1	1.3	2.8	3.7	1.3
SA-20 (K170.4 - SH89.6 - SA113.5)	9	8.0	3300	23	7.6	8.7	9.8	1.7	3.5	4.5	1.5
SH-22 (K170.4 - SH177.0)	11	8.1	870	47	8.5	9.1	9.5	0.8	1.6	2.3	2.7

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Kansas River Survey
6th Limited Run - coll 11-14-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box
Column (11) - Nitrate (as NO_3) in mg/l

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
K-2 (K20.3)	9	8.2	710.	27	11.5	8.4	11.0	0.4	1.8	3.5	2.2
K-5 (K64.1)	10	8.2	720.	32	11.0	8.4	10.2	0.8	2.2	3.9	2.7
K-7 (K84.0)	8	8.1	1010.	23	11.2	8.4	8.7	0.4	2.5	3.8	---
K-8 (K129.1)	7	8.3	760.	33	10.7	9.5	9.8	0.7	1.1	1.7	2.7
R-9 (K147.1 - R7.3)	8	8.3	440.	14	11.4	9.3	9.4	0.4	0.6	0.7	3.1
R-11 (K170.4 - R6.0)	9	8.4	800.	21	11.5	9.4	9.6	0.2	0.6	0.8	2.7
SH-12 (K170.4 - SH43.3)	9	8.3	2820.	14	13.1	9.9	12.3	0.4	1.7	2.5	1.5
SO-18 (K170.4 - SH68.3 - SO155.1)	4	8.2	1150.	24	10.7	8.9	8.6	0.5	1.1	1.8	2.7
SA-20 (K170.4 - SH89.6 - SA113.5)	4	8.1	3450.	36	9.6	8.6	7.8	1.8	3.4	4.8	1.7
SH-22 (K170.4 - SH177.0)	7	8.1	930	15	9.6	8.9	8.9	0.5	1.1	1.7	2.7

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Kansas River Survey
7th Limited Run - coll 11-28-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box
Column (11) - Nitrate (as NO_3) in mg/l

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
K-2 (K20.3)	8	8.0	660	36	10.9	9.3	11.3	0.8	2.0	4.2	2.7
K-5 (K64.1)	8	8.1	700	17	11.3	9.2	12.2	0.8	1.7	2.7	2.2
K-7 (K84.0)	7	8.3	680	11	12.3	9.8	12.0	0.6	1.2	2.0	1.5
K-8 (K129.1)	5	8.3	660	23	11.5	9.5	9.8	0.9	1.3	2.3	2.2
B-9 (K147.1 - B7.3)	7	8.2	450	10	11.5	9.7	9.7	0.4	0.5	0.8	2.7
R-11 (K170.4 - R6.0)	4	8.4	660	19	12.7	9.4	12.9	0.7	1.7	3.0	1.5
SH-13 (K170.4 - SH43.3)	6	8.3	2820	25	11.0	9.3	10.7	0.5	1.3	1.8	1.5
SO-18 (K170.4 - SH68.3 - SO155.1)	1	8.2	1120	13	11.7	9.0	8.7	0.4	1.1	1.6	2.2
SA-20 (K170.4 - SH89.6 - SA113.5)	1	8.2	3500	28	11.5	8.5	10.0	1.0	2.4	3.6	1.5
SH-22 (K170.4 - SH177.0)	4	8.1	990	14	10.1	8.5	8.2	1.0	2.1	2.8	2.2

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
8th Limited Run - coll 12-12-66

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	5	7.9	780	13	9.6	9.0	10.0	0.8	1.7	3.0
K-5 (K64.1)	6	8.0	870	17	13.0	8.3	8.5	0.5	1.6	2.6
K-7 (K34.0)	6	8.2	820	9.6	13.2	9.0	9.6	1.3	2.0	2.6
K-8 (K129.1)	0	8.2	680	5.2	13.0	8.7	8.8	0.1	0.7	1.0
B-9 (K147.1 - B7.3)	3	8.2	470	4.8	12.4	8.7	9.0	0.2	0.5	0.6
R-11 (K170.4 - R6.0)	1	8.3	710	13	13.1	8.7	9.4	0.5	1.2	2.0
SH-13 (K170.4 - SH43.3)	0	8.2	2780	6.4	13.8	9.0	9.0	0.2	0.6	1.0
SO-18 (K170.4 - SH68.3 - SO155.1)	0	8.1	1470	8.8	12.0	8.5	7.8	0.9	1.4	1.9
SA-20 (K1704 - SH89.6 - SA113.5)	0	8.0	4260	17	12.2	8.2	7.8	0.8	1.5	2.5
SH-22 (K170.4 - SH177.0)	2	8.1	1010	8.8	11.4	8.5	8.4	0.6	1.4	2.2

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
9th Limited Run - coll 1-9-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	5	8.0	1170.	22.	13.6	8.2	8.5	0.5	1.8	2.9
K-5 (K54.1)	5	7.8	1190.	22.	12.7	8.2	8.3	0.5	1.8	2.7
K-7 (K04.0)	5	8.0	1260.	18.	13.9	8.2	8.3	0.4	0.6	1.2
K-8 (K129.1)	0	8.2	1130.	21.	14.7	8.8	8.6	0.6	1.4	2.1
B-9 (K147.1 - B7.3)	1	8.2	520.	16.	12.9	8.5	8.8	0.1	0.6	0.8
R-11 (K170.4 - R6.0).	3	8.4	720.	14.	15.0	8.3	8.4	0.2	0.5	0.9
SH-13 (K170.4 - SH43.3)	0	8.2	3000.	16.	15.4	8.7	8.7	0.1	0.6	1.0
SO-18 (K170.4 - SH68.3 - SO155.1)	0	8.0	1480.	17	5.1	6.7	6.3	0.5	1.0	1.5
SA-20 (K170.4 - SH89.6 - SA113.5)	0	7.9	4430.	25.	8.5	7.4	7.1	0.4	1.0	1.4
SH-22 (K170.4 - SH177.0)	1	8.1	1050.	16.	11.8	7.8	7.5	0.6	1.4	2.0

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
10th Limited Run - coll 1-23-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	9	8.1	1080	13	11.5	7.6	8.4	0.5	2.1	3.2
K-5 (K64.1)	8	8.1	950	16	12.3	7.6	8.1	0.5	1.8	2.8
K-7 (K84.0)	7	8.3	990	17	12.6	7.5	8.5	0.5	1.1	2.0
K-8 (K129.1)	0	8.2	1170	12	11.8	7.9	8.8	0.5	1.0	1.8
B-9 (K147.1 - B7.3)	3	8.2	500	14	12.4	7.9	8.1	0.2	0.7	1.1
R-11 (K170.4 - R6.0)	5	8.3	770	12	13.9	8.0	8.0	0.3	1.0	1.4
SH-13 (K170.4 - SH43.3)	4	8.2	2950	12	15.1	8.4	8.4	0.3	0.7	1.4
SO-18 (K170.4 - SH68.3 - SO155.1)	1	8.1	1250	56	8.3	7.0	8.0	1.4	3.0	4.6
SA-20 (K170.4 - SH89.6 - SA113.5)	1	8.0	3780	14	9.1	7.1	6.3	0.8	1.8	2.3
SH-22 (K170.4 - SH177.0)	1	8.1	1050	12	11.1	7.6	7.0	1.0	1.9	2.4

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
11th Limited Run - coll 2-6-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10
K-2 (K20.3)	0	8.1	1150	20	11.9	8.6	10.0	0.9	2.0	3.5
K-5 (K64.1)	0	8.0	1060	18	12.9	8.2	9.2	0.9	2.2	3.3
K-7 (K84.0)	0	8.3	1070	18	13.1	7.8	8.7	0.6	1.2	2.2
K-8 (K129.1)	0	8.3	1090	17	13.2	8.4	9.2	0.7	1.7	3.0
B-9 (K147.1 - B7.3)	0	8.3	520	16	13.6	8.6	8.7	0.3	1.0	1.4
R-11 (K170.4 - R6.0)	0	8.3	700	14	13.1	8.6	8.4	0.5	1.0	1.5
SH-13 (K170.4 - SH43.3)	0	8.2	2480	13	12.0	8.2	8.5	0.2	0.5	0.9
SC-18 (K170.4 - SH68.3 - SC155.1)	-	8.1	1140	12	12.7	8.5	8.2	0.5	1.1	1.9
SA-20 (K170.4 - SH89.6 - SA113.5)	-	8.1	3810	19	11.8	8.1	7.5	0.6	1.3	1.9
SH-22 (K170.4 - SH177.0)	-	8.0	1090	21	11.8	8.5	9.3	0.4	1.2	2.0

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
12th Limited Run - coll 2-20-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	0	8.3	1070	20	14.4	8.2	13.1	1.6	3.7	4.9
K-5 (K64.1)	0	8.1	1020	24	13.1	8.5	21.0	1.7	3.5	4.9
K-7 (K84.0)	0	8.3	1020	23	12.3	8.5	11.5	0.9	1.7	3.0
K-8 (K129.1)	2	8.4	1010	21	13.7	8.5	9.0	0.9	2.2	3.8
B-9 (K147.1 - B7.3)	2	8.4	490	22	14.5	8.8	9.8	0.7	1.8	2.8
R-11 (K170.4 - R6.0)	2	8.4	660	22	12.9	8.6	10.4	1.0	2.2	3.1
SH-13 (K170.4 - SH43.3)	2	8.3	2590	15	14.0	8.8	14.5	0.6	1.5	2.6
SO-18 (K170.4 - SH66.3 - SO155.1)	0	8.2	1150	16	12.7	8.6	7.9	0.8	1.5	2.0
SA-20 (K170.4 - SH89.6 - SA113.5)	-1	8.2	3650	23	11.9	8.1	7.9	0.4	1.2	1.9
SH-22 (K170.4 - SH177.0)	0	8.2	1030	16	11.6	8.4	8.5	0.6	1.7	2.0

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
13th Limited Run - coll 3-13-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	9	8.4	1200	50	10.7	7.7	34.9	5.3	11.	16.
K-5 (K54.1)	9	8.1	1230	34	12.0	8.2	23.1	3.1	6.3	9.5
K-7 (K84.0)	9	8.5	1180	33	11.5	8.1	14.1	2.2	4.8	7.6
K-8 (K129.1)	8	8.5	1200	27	13.2	8.7	14.6	2.3	4.6	7.0
B-9 (K147.1 - B7.3)	6	8.2	320	20	10.8	8.5	8.8	0.5	1.4	2.3
R-11 (K170.4 - R6.0)	5	8.4	610	22	12.0	8.7	9.4	0.4	1.4	2.0
SH-13 (K170.4 - SH43.3)	9	8.4	2620	24	11.0	8.7	21.2	2.1	4.5	6.7
SO-18 (K170.4 - SH68.3 - SO155.1)	7	8.2	1330	14	9.8	7.6	5.8	2.4	4.6	5.5
SA-20 (K170.4 - SH89.6 - SA113.5)	8	7.8	4730	21	7.7	7.1	11.7	0.9	1.9	3.2
SH-22 (K170.4 - SH177.0)	6	8.0	1060	11	10.6	7.9	8.3	0.6	1.9	2.7

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
14th Limited Run - coll 3-27-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	11	8.4	1100	47	13.7	8.1	22.8	3.9	9.0	14.
K-5 (K64.1)	11	8.0	1150	28	12.0	7.9	16.2	2.1	4.8	7.2
K-7 (K84.0)	11	8.3	1000	35	11.2	7.8	15.6	2.2	4.4	6.6
K-8 (K129.1)	10	7.9	830	125	5.3	6.4	10.7	2.2	8.2	16.
B-9 (K147.1 - B7.3)	10	8.3	530	28	9.4	8.1	8.3	0.7	1.5	2.7
R-11 (K170.4 - R6.0)	12	8.4	590	18	11.0	8.4	8.9	0.4	1.0	1.7
SH-13 (K170.4 - SH43.3)	15	8.6	2740	33	10.3	9.5	17.6	2.3	4.6	7.4
SO-18 (K170.4 - SH68.3 - SO155.1)	10	8.2	1250	20	8.5	7.7	8.8	1.4	2.9	3.7
SA-20 (K170.4 - SH89.6 - SA113.5)	11	8.1	4560	38	6.4	7.3	16.3	1.7	3.5	5.7
SH-22 (K170.4 - SH177.0)	9	8.3	1100	14	9.4	7.7	8.2	1.3	2.4	3.8

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey
15th Limited Run - coll 4-10-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	14	7.9	650	38	8.3	9.2	10.3	0.8	2.9	7.4
K-5 (K64.1)	16	7.8	740	42	8.2	8.8	9.7	0.7	1.9	3.5
K-7 (K84.0)	15	8.2	660	40	8.9	9.3	10.2	1.1	2.8	5.2
K-8 (K129.1)	12	8.3	700	28	8.9	10.4	13.1	1.3	3.2	5.0
B-9 (K147.1 - B7.3)	13	8.4	530	24	9.4	11.0	12.4	1.3	2.8	4.2
R-11 (K170.4 - R6.0)	16	8.5	580	20	9.5	10.2	10.0	0.6	1.2	1.7
SH-13 (K170.4 - SH43.3)	16	8.4	1850	36	7.9	10.8	14.4	1.6	3.6	5.6
SO-18 (K170.4 - SH68.3 - SO155.1)	11	8.0	1200	26	8.8	8.7	22.7	2.0	4.0	6.7
SA-20 (K170.4 - SH89.5 - SA113.5)	12	8.0	5380	40	6.8	7.6	19.5	2.5	5.2	9.5
SH-22 (K170.4 - SH177.0)	14	8.2	1150	18	8.1	8.8	9.6	0.5	1.0	1.6

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey

16th Limited Run - coll 4-24-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	8	7.9	600	23	10.4	9.0	15.6	1.2	2.4	4.5
K-5 (K64.1)	8	8.0	790	23	11.9	9.0	14.8	1.8	4.0	6.1
K-7 (K84.0)	8	8.3	780	28	11.8	9.0	14.0	2.2	4.9	7.5
K-8 (K129.1)	7	8.4	1090	27	11.4	9.8	13.6	1.8	3.8	7.0
B-9 (K147.1 - B7.3)	11	8.4	520	15	9.7	9.8	10.5	0.5	1.6	2.4
R-11 (K170.4 - R6.0)	13	8.4	590	10	11.7	10.0	9.9	0.1	0.3	0.5
SH-13 (K170.4 - SH43.3)	13	8.3	2010	26	8.9	9.3	16.5	1.6	3.7	5.9
SO-18 (K170.4 - SH68.3 - SO155.1)	5	8.2	1220	13	11.1	9.7	14.5	1.5	2.6	3.5
SA-20 (K170.4 - SH89.5 - SA113.5)	5	8.2	4580	26	9.5	8.8	10.8	3.2	6.2	8.0
SH-22 (K170.4 - SH177.0)	11	8.3	1110	12	9.6	9.3	9.0	0.7	1.3	1.8

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey

17th Limited Run - coll 5-1-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	14	8.6	820	52	10.7	9.3	35.0	4.3	8.4	15
K-5 (K64.1)	15	8.2	1240	39	10.7	8.3	28.7	3.0	6.2	11
K-7 (K84.0)	15	8.2	1140	44	9.6	7.5	11.0	2.7	5.7	10
K-8 (K129.1)	11	8.4	1320	43	10.0	8.6	16.6	2.0	5.7	10
B-9 (K147.1 - B7.3)	13	8.4	530	23	8.5	8.2	10.7	0.6	1.8	2.8
R-11 (K170.4 - R6.0)	10	8.4	590	13	11.4	8.9	8.8	0.2	0.5	0.8
SH-13 (K170.4 - SH43.3)	15	8.5	2060	38	9.5	9.1	17.9	1.9	4.3	6.4
SO-18 (K170.4 - SH68.3- SO155.1)	11	8.1	1020	25	7.9	7.5	14.4	1.1	2.6	3.9
SA-20 (K170.4 - SH89.5 - SA113.5)	12	7.8	5270	43	3.9	6.3	12.7	3.2	5.8	8.0
SH-22 (K170.4 - SH177.0)	11	8.0	1170	20	9.0	8.1	7.9	1.1	2.4	3.3

HAS:lj

THE KANSAS STATE DEPARTMENT OF HEALTH
Sanitary Engineering Laboratory

Kansas River Survey

18th Limited Run - coll 5-15-67

Column (1) - Station Number
Column (1A) - Temperature °C
Column (2) - pH
Column (3) - Specific Conductance
Column (4) - Chemical Oxygen Demand, mg/l
Column (5) - Dissolved Oxygen, mg/l, at time of collection
Column (6) - Dissolved Oxygen, mg/l, when incubation started
Column (7) - Dissolved Oxygen, mg/l, after 1 day in light box at 20°C
Column (8) - 1 day 20°C BOD, mg/l, dark box
Column (9) - 3 day 20°C BOD, mg/l, dark box
Column (10) - 6 day 20°C BOD, mg/l, dark box

(1)	(1A)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
K-2 (K20.3)	14	8.4	850	38	12.8	8.6	21.0	3.0	6.1	9.8
K-5 (K64.1)	15	8.0	1160	38	10.7	7.9	18.0	2.3	4.6	6.8
K-7 (K84.0)	15	8.2	1130	34	9.8	8.1	16.9	2.3	4.3	7.4
K-8 (K129.1)	12	8.4	1250	38	11.2	8.6	11.0	1.6	4.0	6.8
B-9 (K147.1 - B7.3)	13	8.2	530	14	9.4	8.1	9.0	0.3	0.8	1.3
R-11 (K170.4 - R6.0)	14	8.4	580	16	13.8	9.1	9.1	0.2	0.4	0.7
SH-13 (K170.4 - SH43.3)	14	8.5	2430	38	10.3	9.0	16.0	2.6	5.6	8.4
SO-18 (K170.4 - SH68.3 - SO155.1)	12	8.2	1120	31	8.9	7.8	31.9	2.2	4.4	6.7
SA-20 (K170.4 - SH89.5 - SA113.5)	11	8.1	4450	33	6.9	7.0	13.3	1.4	2.8	4.3
SH-22 (K170.4 - SH177.0)	12	8.1	1160	14	8.3	7.7	7.4	0.7	1.3	2.0

-A
MAS:lj

INTENSIVE SAMPLING

An intensive sampling program was carried out below Tescott along the Saline River on July 13, 14 and 15, 1966. The purpose of the intensive sampling was to obtain a field determination of the reaeration constants for the Saline River under high temperature and low flow conditions. The study area was a 12 mile reach of stream below the outfall of the Tescott Cheese Plant, which was providing the BOD loading for the existing oxygen sag. Five stations along the river were sampled every 3 hours for DO and BOD from dawn of July 13 through mid-morning of July 15, making a total of 80 sampling periods. BOD samples were composited every 12 hours for a final total of 20 samples. Duplicate BOD samples were incubated at 20°C for 3 and 6 days in a dark box. In addition, simultaneous light and dark bottle BOD samples were incubated in the river at each station for the purpose of oxygen demand rate determinations.

The data collected during the study, including dissolved oxygen, 3 and 6 day 20°C dark box BOD, temperature, and pH, is presented on the following pages.

State Department of Health
Topeka

MEMORANDUM

Date August 9, 1966

To: Mel Gray

From: Howard A. Stoltenberg

Subject: Saline River Intensive Study - 1st Composite Period

#1 Saline River, upstream 100 yards from cheese plant.

#2 Saline River, Tescott Cheese Plant effluent.

#3 SA-19 (Saline River 1/4 mile downstream from effluent).

#4 Saline River bridge 67 (3.4 miles downstream from SA-19).

#5 Saline River bridge 66 (8.2 miles downstream from SA-19).

Sta.	Time of Collection	* Temp.	* mg/l Dissolved Oxygen	* pH	Composite Sample mg/l 3 day 20°C BOD	mg/l 6 day 20°C BOD
1	5:45 AM, 7-13-66	26°C	3.6			
	8:55 AM, 7-13-66	27°C	4.0			
	12:05 PM, 7-13-66	29°C	6.0			
	3:00 PM, 7-13-66	30°C	3.0	7.0	220.	-----
2	5:55 AM, 7-13-66	27°C	4.0			
	8:55 AM, 7-13-66	28°C	2.9			
	12:05 PM, 7-13-66	32°C	4.8			
	3:00 PM, 7-13-66	31°C	7.8	7.4	145.	165.
3	6:05 AM, 7-13-66	26°C	3.4			
	9:10 AM, 7-13-66	27°C	3.2			
	12:20 PM, 7-13-66	30°C	5.5			
	3:25 PM, 7-13-66	31°C	7.0	7.9	5.7	8.0
4	6:15 AM, 7-13-66	26°C	2.3			
	9:20 AM, 7-13-66	26°C	3.5			
	12:40 PM, 7-13-66	30°C	7.3			
	3:40 PM, 7-13-66	31°C	8.7	8.1	5.4	7.0
5	6:25 AM, 7-13-66	26°C	3.6			
	9:40 AM, 7-13-66	27°C	5.1			
	12:50 PM, 7-13-66	30°C	9.3			
	3:50 PM, 7-13-66	31°C	10.7	8.4	4.8	7.2

HAS:lj

State Department of Health
Topeka

MEMORANDUM

Date August 9, 1966

To: Mel Gray

From: Howard A. Stoltenberg

Subject: Saline River Intensive Study - 2nd Composite Period

#1 Saline River, upstream 100 yards from cheese plant.
#2 Saline River, Tescott Cheese Plant effluent.
#3 SA-19 (Saline River 1/4 mile downstream from effluent).
#4 Saline River bridge 67 (3.4 miles downstream from SA-19).
#5 Saline River bridge 66 (8.2 miles downstream from SA-19).

* * *

Sta.	Time of Collection	Temp.	mg/l Dissolved Oxygen	pH	Composite Sample mg/l 3 day 20°C BOD	mg/l 6 day 20°C BOD
1	5:50 PM, 7-13-66	32°C	6.6			
	9:25 PM, 7-13-66	29°C	5.8			
	12:45 AM, 7-14-66	28°C	5.0			
	3:30 AM, 7-14-66	27°C	4.8	8.3	3.5	5.5
2	5:50 PM, 7-13-66	28°C	3.7			
	9:25 PM, 7-13-66	27°C	6.1			
	12:45 AM, 7-14-66	27°C	5.1			
	3:40 AM, 7-14-66	26°C	5.3	7.8	160.	225.
3	6:00 PM, 7-13-66	30°C	5.1			
	9:45 PM, 7-13-66	29°C	4.1			
	1:08 AM, 7-14-66	27°C	3.7			
	4:00 AM, 7-14-66	27°C	3.4	8.2	9.0	12.
4	6:05 PM, 7-13-66	31°C	7.7			
	10:00 PM, 7-13-66	29°C	4.5			
	1:30 AM, 7-14-66	27°C	0.0			
	4:25 AM, 7-14-66	26°C	0.0	7.7	55.	66.
5	6:25 PM, 7-13-66	30°C	11.7			
	10:15 PM, 7-13-66	29°C	9.1			
	1:50 AM, 7-14-66	28°C	5.9			
	5:00 AM, 7-14-66	27°C	4.4	8.3	10.	17.

HAS:lj

State Department of Health
Topeka

MEMORANDUM

Date August 10, 1966

To: Mel Gray

From: Howard A. Stoltenberg

Subject: Saline River Intensive Study - 3rd Composite Period

#1 Saline River, Upstream 100 yards from cheese plant.
#2 Saline River, Tescott Cheese Plant effluent.
#3 SA-19 (Saline River 1/4 mile downstream from effluent).
#4 Saline River bridge 67 (3.4 miles downstream from SA-19).
#5 Saline River bridge 66 (8.2 miles downstream from SA-19).

* * *

Sta.	Time of Collection	Temp.	mg/l Dissolved Oxygen	Composite Sample mg/l 3 day 20°C BOD	mg/l 6 day 20°C BOD
1	7:00 AM, 7-14-66	26°C	4.0		
	8:55 AM, 7-14-66	28°C	4.3		
	3:50 PM, 7-14-66	31°C	7.3	3.5	5.0
2	7:00 AM, 7-14-66	26°C	4.2		
	8:55 AM, 7-14-66	26°C	4.7		
	3:50 PM, 7-14-66	31°C	6.2	75.	140.
3	7:20 AM, 7-14-66	26°C	3.2		
	9:05 AM, 7-14-66	28°C	3.8		
	3:40 PM, 7-14-66	32°C	5.3	19.	25.
4	7:35 AM, 7-14-66	26°C	0.1		
	9:20 AM, 7-14-66	27°C	1.1		
	1:50 PM, 7-14-66	----	8.3		
	3:30 PM, 7-14-66	32°C	10.5	8.5	13.
5	7:50 AM, 7-14-66	----	3.2		
	9:40 AM, 7-14-66	28°C	4.6		
	3:05 PM, 7-14-66	31°C	11.4	8.6	13.

HAS:lj

State Department of Health
Topeka

MEMORANDUM

Date August 10, 1966

To: Mel Gray

From: Howard A. Stoltenberg

Subject: Saline River Intensive Study - 4th Composite Period

#1 Saline River, upstream 100 yards from cheese plant.
#2 Saline River, Tescott Cheese Plant effluent.
#3 SA-19 (Saline River 1/4 mile downstream from effluent).
#4 Saline River bridge 67 (3.4 miles downstream from SA-19).
#5 Saline River bridge 66 (8.2 miles downstream from SA-19).

* * *

Sta.	Time of Collection	Temp.	mg/l Dissolved Oxygen	Composite Sample mg/l 3 day 20°C BOD	mg/l 6 day 20°C BOD
1	5:40 PM, 7-14-66	30°C	7.2		
	10:20 PM, 7-14-66	29°C	5.6		
	6:35 AM, 7-15-66	27°C	3.4	5.7	8.5
2*	5:40 PM, 7-14-66	32°C	6.2	100.	125.
	6:35 AM, 7-15-66	27°C	3.2	6.0	10.
3	5:50 PM, 7-14-66	31°C	5.5		
	10:00 PM, 7-14-66	28°C	3.9		
	11:40 PM, 7-14-66	28°C	3.8		
	6:50 AM, 7-15-66	28°C	2.6	14.	21.
4	6:00 PM, 7-14-66	----	9.7		
	10:30 PM, 7-14-66	30°C	5.1		
	12:15 AM, 7-15-66	29°C	4.6		
	7:00 AM, 7-15-66	27°C	2.8	3.9	6.4
5	6:15 PM, 7-14-66	31°C	10.7		
	10:50 PM, 7-14-66	29°C	7.8		
	12:01 AM, 7-15-66	30°C	7.6		
	7:50 AM, 7-15-66	27°C	2.9	4.7	7.7

* BOD's were run on each of the single grab samples as indicated.

HAS:lj

TIME OF TRAVEL STUDIES

Time of travel determinations using a liquid tracer dye were made for the main stem reaches of the project area under varying flow conditions. The reaches studied were the Solomon River from Beloit to Solomon; the Saline River from Sylvan Grove to New Cambria; the Smoky Hill River from Kanopolis Dam to Junction City; and the Kansas River from Junction City to Bonner Springs. Seasonal flow variations were studied for the above rivers from March, 1966 through July, 1967. It was the intent of the project to arrive at a discharge-velocity relationship for each of the above rivers using velocity determinations from three different flow conditions. The discharge-velocity curves derived from the study are presented following the dye recovery curves at the end of the report.

Dye Characteristics

The tracer used in the time of travel measurements was DuPont Rhodamine B liquid, 40% dye by weight in acetic acid, specific gravity 1.12. It is a deep red liquid which is highly miscible with water and spreads very rapidly until diluted sufficiently in the stream. The dye is adsorbed readily onto suspended and bottom sediments, rocks, vegetation, tree limbs, and other obstructions in the river channel. In addition, the dye undergoes photochemical decay in intense sunlight, the magnitude of destruction being directly proportional to exposure time. These two unmeasurable properties make complete recovery of the injected dye mass impossible.

Vertical mixing of the dye takes place immediately at the point of injection, while lateral and longitudinal mixing are continuing processes. Lateral mixing across the entire channel width was found to be accomplished generally within one mile for flows below 1000 cfs. At greater than 1000 cfs, lateral mixing is accomplished in about 5 miles. Longitudinal mixing continues slowly until the dye is ultimately dispersed. A great many factors

affect the longitudinal mixing of the dye and thus affect the final shape of the recovery curve. Among these factors are the amount of flow; the velocity; the physical lay of the channel; channel shape and roughness; number of constrictions and bends; sandbars and island braiding; depth of flow; wind; tributary inflow; trash, dead wood and other obstructions in the channel; and low water dams. Trailing effects resulting from combinations of the above factors spread the dye longitudinally as it moves downstream. Over a 50 mile reach, an initial dye slug of 2 gallons can spread to a length of about 15 miles. This complicates recovery and makes identification of the dye peak more difficult.

Field Procedures

For the type of information sought in these studies, there are three methods readily available for injecting the dye into the stream. These are single point injection into the primary flow channel; multiple point injection along a cross section; and continuous injection along a cross section. The latter method is done from a boat, traversing the stream perpendicular to the flow. This method is desirable where velocity is high and median discharge is in the range of 50,000 cfs, but is generally not feasible for the stream types in Kansas. The other two methods were compared on the Kansas River, but essentially no difference was found in the results obtained. Single point injection was used for the majority of the dye dumps.

For the purpose of mixing, the dumps were made from bridges when the flow depth was estimated greater than two feet. At shallower depths, dumping from bridge height causes lodging of the dye in bottom muds resulting in slow bleed-off which flattens the recovery peak. In these cases, the dye was lowered in buckets to the stream surface and poured gently into the flow.

The time of travel studies were undertaken as flow conditions and weather permitted for each river. Whenever possible, consistent with stable flow conditions, successive reaches were studied simultaneously. Usually three successive reaches were studied at the same time, with dumps made according to length of reach so that recovery times would coincide.

Dye recovery was done by the grab sample method with sampling frequency being every hour or half hour, depending on the estimated duration of passage of the dye slug. After passage of the peak, sampling for recovery was continued until fluorometer results approached previously established backgroumd readings.

Dye concentrations for the samples were converted from percent light transmissibility readings obtained with Model 4-7102 Aminco Fluoro-Microphotometers which were equipped with standard fluorescent band filters. For the purpose of minimizing background readings due to high turbidities, samples were settled for a half hour before testing. Since fluorescence of the dye varies inversely with temperature change, samples were sheltered for temperature equalization when environmental temperatures were extreme.

Estimation of Dye Quantities

Estimation of the quantity of dye to be dumped for a particular study involves a number of assumptions and/or predetermined values. Both physical and hydrologic characteristics of the stream must be considered in a quantity estimation.

Following are two formulas which may be used for estimation of dye quantity:

$$(1) \qquad M = \frac{CA(NX)^{\frac{1}{2}} R^{5/12}}{1.1 \times 10^3}$$

where, M = Weight of dye in grams

C = Maximum concentration desired at downstream point in ppb

A = Cross sectional area of stream at release point in square feet

N = Manning's coefficient for channel roughness

X = Distance between release and monitoring points in feet

R = Mean depth of stream between release and monitoring points in feet

Maximum concentration desired at the monitoring point is a matter of decision for the investigators. Safety considerations may be paramount in this regard, depending on the existing water uses of the reach under study. The Food and Drug Administration has established a maximum tolerance limit for ingestion of Rhodamine B at 0.75 milligrams per day, or based on normal water consumption, 370 ppb. Aesthetic considerations should also be taken into account if the stream flows in or near population centers. The dye is visible in river water in concentration ranges of 10 - 30 ppb. A value of 2 to 10 ppb is reasonable for inclusion in the above formula.

The distance between release and monitoring points can be obtained readily with a mileage wheel from aerial photographs or quadrangle maps. A check should be made to find out whether channel improvements have been made since the date of the photographs or maps.

The cross sectional area of the stream at the release point can be estimated visually at the site, or calculated roughly from flow and velocity estimations.

Mean depth of the stream between the release and monitoring points can be difficult to estimate, particularly if the reach under consideration contains alternate riffle and pool areas, as do the upper tributaries in the project area.

Manning's coefficient for channel roughness must be estimated on the basis of the characteristics of the streambed. A value in the range of 0.03 - 0.04 is usually reasonable.

(2) $$\text{Dose (ml.)} = \frac{0.15\ QLC}{V}$$

Where, Q = Discharge in cfs

L = Length of reach in miles

C = Desired average concentration in ppb

V = Average velocity in feet per second

Either formula can be used with satisfactory results. Formula (2) will give a somewhat larger dose for the same reach of river. Experimentation with estimated dye quantities is advisable for different types of reaches because of dye losses due to adsorption and decay.

Description of the Project Area

Kansas River

The Kansas River was studied from Junction City to Bonner Springs, a total river mileage of 153.0 miles. The river was divided into six reaches using the following division points: Junction City (river mile 172.8), Manhattan (146.0), Wamego (124.0), Topeka (81.2), Lecompton (62.4), Lawrence (50.6), and Bonner Springs (19.8). U. S. Geological Survey gaging stations are located at Fort Riley, Wamego, Topeka, Lecompton, and Bonner Springs. The Kansas River is a wide, shallow, relatively slow moving stream. At median flow the width averages around 400 to 500 feet and the depth averages around 3 to 4 feet. The streambed is primarily shifting sand and silt. At low flow the channel is badly braided resulting in spreading of the dye slug and lowering of the peak concentration. A wide variation of flows was encountered on the Kansas River during the period of the project. Flows at Bonner Springs, essentially the control point

for the project area, varied from 400 cfs in late winter to 115,000 cfs in early summer. A significant feature in the flow pattern of the Kansas River is the measurable lowering of the velocity between Lecompton and Lawrence due to the Bowersock Mill and Power Company dam at Lawrence. The effect is evident at all flows less than about 6,000 cfs.

Smoky Hill River

The Smoky Hill River was studied from Kanopolis Dam to Junction City, a total river mileage of 182.4 miles. The river was divided into four reaches using the following division points: Kanopolis Dam (184.4), Lindsborg (147.0), Salina (102.2), Abilene (54.8), and Junction City (2.0). U. S. Geological Survey gaging stations are located at Langley (Kanopolis Dam), Mentor, New Cambria, and Enterprise. The Smoky Hill River is a widely meandering stream of moderate velocity. At median flow the width averages around 100 - 150 feet and the depth averages around 2 - 5 feet. The streambed is primarily silt and gravel. Low flow does not severely affect channelization as it does on the Kansas River. Silt loads in the Smoky Hill River are extremely high, contributing to loss of dye through adsorption. Overflow dams at Marquette, Lindsborg, Abilene, and Enterprise affect the velocity of the river at low flow.

Solomon River

The Solomon River was studied from Beloit to Solomon, a total river mileage of 132.0 miles. The river was divided into four reaches using the following division points: Beloit (136.4), Glasco (101.8), Minneapolis (55.2), Bennington (42.2), and Solomon (4.4). Shorter reaches within these four were studied at low flow because of the slower velocities encountered. U. S. Geological Survey gaging stations are located at Glen Elder and Niles. The Solomon River is a well channelized, meandering stream of low velocity. At median flow the width averages around 75 feet

and the depth averages around 2 - 5 feet. The streambed is composed primarily of silt and gravel. Silt loads are high, contributing to loss of dye through adsorption. Overflow dams at Beloit, Simpson, Delphos, Minneapolis, and Bennington severely affect local velocities at low flow.

Saline River

The Saline River was studied from Sylvan Grove to New Cambria, a total river mileage of 127.0 miles. The river was divided into three reaches using Sylvan Grove (128.8, Lincoln (97.0), Tescott (59.6), and New Cambria (1.8) as the division points. Shorter reaches were studied at low flow because of the slow velocities encountered. U. S. Geological Survey gaging stations are located at Wilson Dam and Tescott. The Saline River is a widely meandering stream of low velocity. At median flow the width averages around 40 feet and the depth averages around 2 - 3 feet. The Saline River demonstrates a more variable depth than the other rivers in the project area. Alternate riffle and pool areas are located along the entire length studied. Depths in these areas vary from 0.5 to 6 feet at low flow. The streambed is primarily silt with small amounts of gravel. Silt loads are high, contributing to loss of dye through adsorption. The channel is heavily loaded with trash and dead wood which also contributes to loss of dye through adsorption, and causes a lowering of the velocity. Overflow dams at Lincoln and Shady Bend further lower the velocity at low flows.

Graphical Results

The results of the time of travel studies for the project area are included in the following pages. The dye recovery curves of dye concentration versus travel time are shown for each study. Travel times computed for each reach, as summarized in Table I, Pages 51 and 52, are based on the time of passage of the peak concentration. River mile figures are the

latest available from aerial photographs and topographical maps. The reaches referred to in Table I are shown on the maps of the project area on pages 53 through 57.

The discharge-velocity curves for the main reaches discussed previously are shown on pages 113 through 128. These curves can be used to predict the average velocity for the reach at essentially any flow. Local flow velocities may vary considerably from the predicted average velocity for a particular reach. This is influenced by depth and width of the flow, trash and other obstructions in the channel, significant tributary inflow, degree of meandering, overflow dams, and other factors. Local flow variations are illustrated on the discharge-velocity curve for the Saline River from Tescott to New Cambria, page 114. The short reaches studied within that portion of the river at low flow demonstrated velocities which did not lie on a smooth curve. It is certain that this condition exists along all of the rivers studied. To assist in determining what flow ranges are included on the discharge-velocity curves, the statistical annual low, median, and flood flows are indicated for each reach. These statistical flows were taken from Technical Reports 1, 2, and 3 published by the Kansas Water Resources Board. Flows included in Table I were provided by the U. S. Geological Survey and the U. S. Army Corps of Engineers. These flow figures are preliminary figures based on gage height readings, and are subject to rating table shifts.

The last four figures in the report show the variation in average velocity plotted against river mileage for each river. The locations of the dye study reaches are shown along the river mileage scale. Average velocity for each reach, at the 50% exceedence flow, was plotted at the end of the reach. It was felt that this more readily identifies the reaches of significant velocity change such as Lecompton - Lawrence on the Kansas River, which reflects the slowing resulting from the power dam at Lawrence.

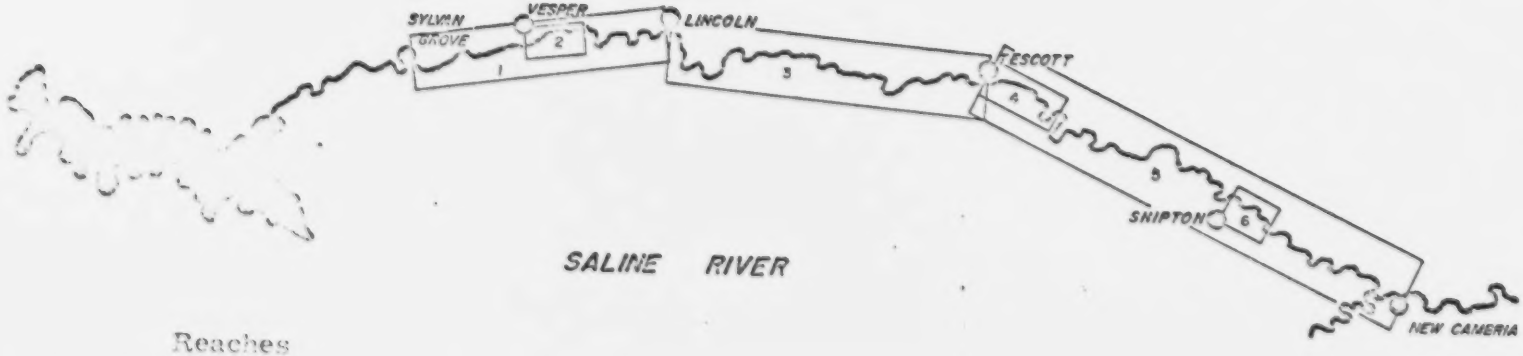
Elevations of each station are plotted above the velocity curves so that velocity changes can be compared to elevation changes. Physical condition of the channel appears to have more influence on velocity, however, than elevation change.

TABLE I

SUMMARY OF DYE STUDY DATA

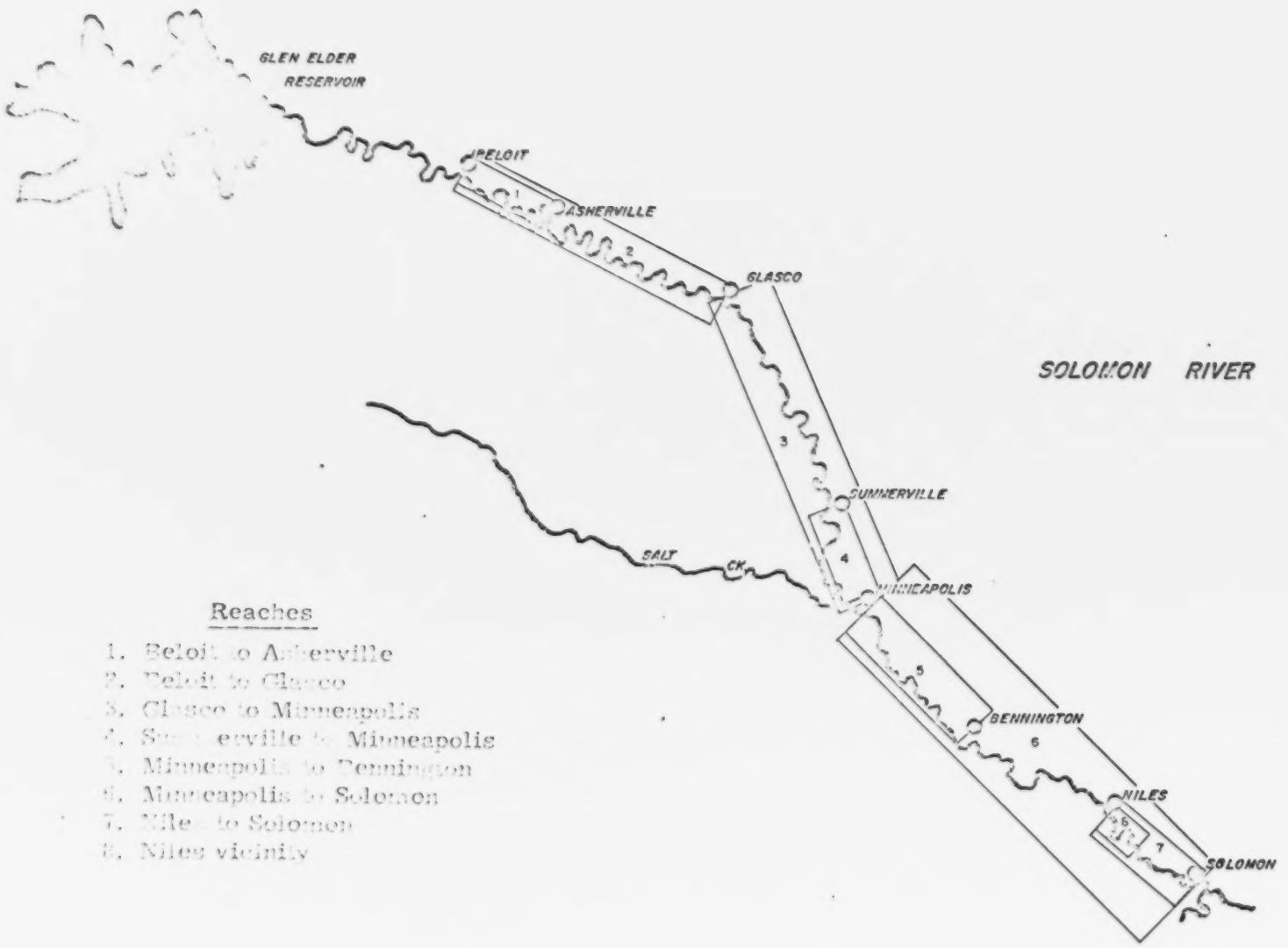
Location	Date	Distance	Travel Time (peak) (hrs)	Velocity (mph)	Velocity (fps)	Flow (cfs)
KANSAS RIVER						
Junction City - Manhattan	3/25/66	26.8	18.8	1.42	2.09	1840
Junction City - Manhattan	5/03/67	26.8	34.0	.79	1.16	285
Junction City - Manhattan	7/17/66	26.8	29.0	.92	1.35	505
Junction City - Manhattan	8/14/66	26.8	22.0	1.22	1.79	1080
Manhattan - Wamego	3/25/66	22.0	18.3	1.20	1.76	2070
Manhattan - Wamego	5/03/67	22.0	29.0	.759	1.12	345
Manhattan - Wamego	7/17/66	22.0	25.0	.88	1.29	700
Manhattan - Wamego	8/16/66	22.0	21.0	1.05	1.54	1210
Wamego - Topeka	3/26/66	42.8	36.8	1.16	1.54	2270
Wamego - Topeka	10/24/66	42.8	43.0	1.00	1.47	850
Wamego - Topeka	5/03/67	42.8	50.5	.85	1.25	420
Wamego - Topeka	6/12/67	42.8	17.0	2.52	3.70	56000
Topeka - Lecompton	3/23/66	18.8	15.0	1.25	1.84	2790
Topeka - Lecompton	10/24/66	23.8	23.5	1.01	1.48	1300
Topeka - Lecompton	4/26/67	18.8	21.0	.90	1.32	1000
Topeka - Lawrence	6/12/67	30.6	13.0	2.35	3.45	86000
Lecompton - Lawrence	3/23/66	11.8	15.6	.76	1.12	2790
Lecompton - Lawrence	10/23/66	11.8	25.0	.47	.69	1330
Lecompton - Eudora	4/26/67	21.0	31.0	.68	.95	1000
Lawrence - Bonner Springs	3/23/66	30.8	25.5	1.21	1.78	2800
Lawrence - Bonner Springs	8/11/66	30.8	28.0	1.10	1.62	2290
Lawrence - Bonner Springs	10/24/66	30.8	32.0	.96	1.41	1400
Lawrence - Bonner Springs	4/26/67	30.8	36.5	.84	1.23	1050
Lawrence - Bonner Springs	6/12/67	30.8	12.5	2.46	3.62	97000
SMOKY HILL RIVER						
Kanopolis - Lindsborg	8/24/66	41.0	14.2	2.83	4.16	330
Kanopolis - Lindsborg	6/07/67	41.0	24.5	1.67	2.45	60
Kanopolis - Lindsborg	6/18/66	41.0	13.0	3.16	4.64	800
Lindsborg - Salina	8/26/66	38.0	17.5	2.17	3.19	380
Lindsborg - Salina	6/07/67	38.0	25.5	1.49	2.19	24
Lindsborg - Salina	6/18/66	38.0	15.0	2.53	3.72	840

Location	Date	Distance	Travel Time (peak) (hrs)	Velocity (mph)	Velocity (fps)	Flow (cfs)
Salina - Abilene	8/31/66	45.4	24.0	1.89	2.78	550
Salina - Abilene	5/31/67	45.4	35.5	1.28	1.88	250
Salina - Solomon	6/28/67	29.0	11.0	2.64	3.88	3220
Abilene - Chapman	6/28/67	28.2	13.0	2.17	3.19	3100
Abilene - Junction City	8/31/66	52.8	48.0	1.10	1.62	590
Abilene - Junction City	5/31/67	52.8	55.0	.96	1.41	380
SALINE RIVER						
Sylvan Grove - Lincoln	6/22/67	31.8	26.5	1.20	1.76	270
Vesper Vicinity	7/20/67	6.8	33.0	.21	.31	13
Lincoln - Tescott	6/22/67	37.4	28.0	1.33	1.96	342
Tescott Vicinity	7/26/66	4.8	15.0	.32	.47	13.1
Tescott Vicinity	7/26/66	3.4	17.0	.20	.29	10.8
Tescott Vicinity	7/20/67	8.2	43.0	.19	.28	15.0
Tescott - New Cambria	8/01/66	49.6	144.0	.34	.50	21.3
Tescott - New Cambria	9/09/66	49.6	60.0	.83	1.10	105
Tescott - New Cambria	6/22/67	49.6	41.0	1.21	1.78	430
Shipton Vicinity	7/20/67	6.6	37.0	.18	.26	18
SOLOMON RIVER						
Beloit - Asherville	8/19/66	17.4	46.5	.37	.54	58
Beloit - Asherville	7/18/67	17.4	27.5	.63	.93	120
Beloit - Glasco	6/20/67	36.2	22.0	1.65	2.42	425
Glasco - Minneapolis	6/20/67	31.6	20.5	1.54	2.26	560
Summerville - Minneaplis	7/18/67	13.4	27.0	.50	.74	135
Minneapolis - Bennington	8/03/66	13.0	17.5	.74	1.09	88.1
Minneapolis - Solomon	6/20/67	50.8	29.0	1.75	2.57	770
Niles Vicinity	7/18/67	9.2	15.5	.59	.87	159
Niles - Solomon	8/03/66	15.0	27.0	.56	.82	120



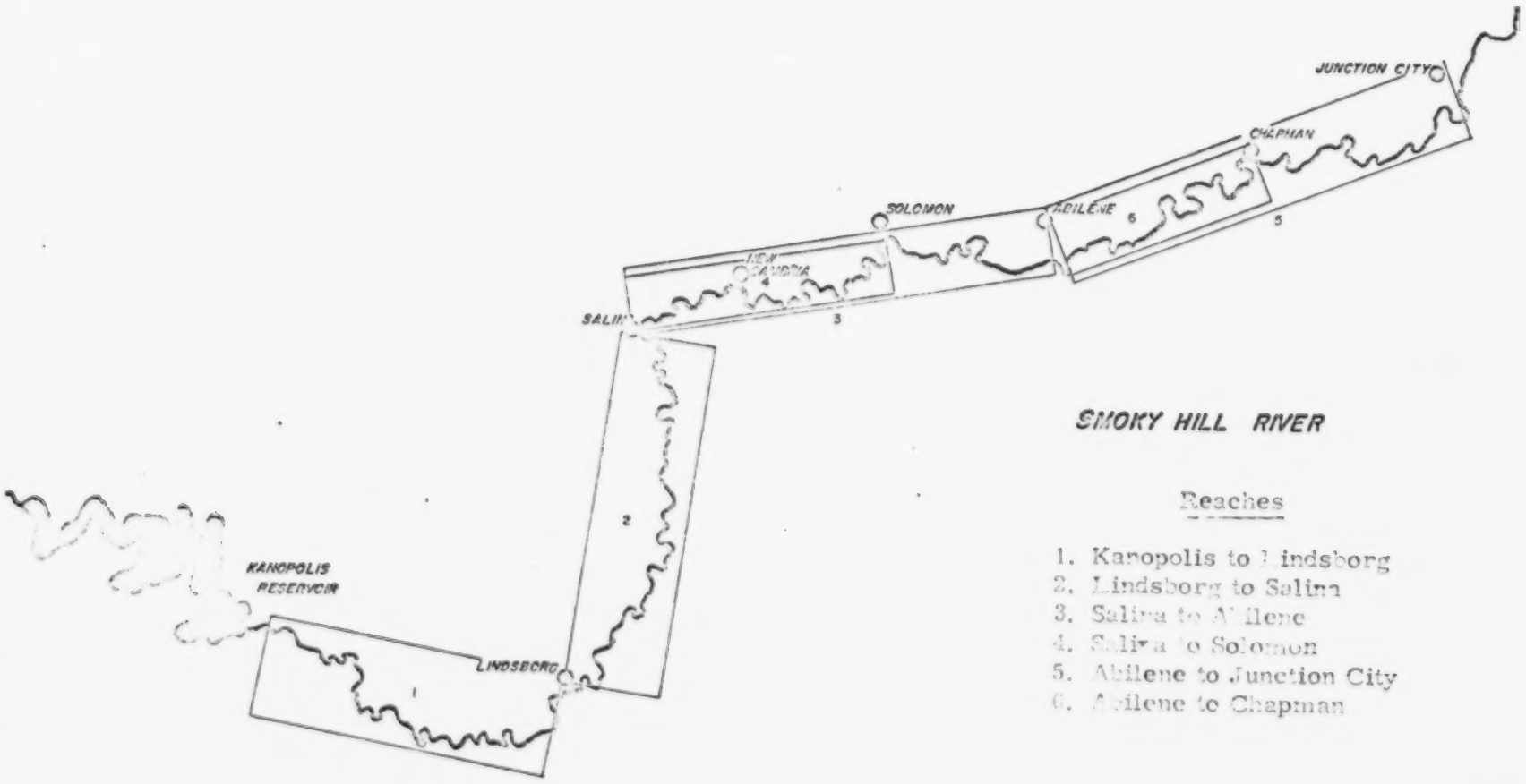
Reaches

1. Sylvan Grove to Lincoln
2. Vesper vicinity
3. Lincoln to Tescott
4. Tescott vicinity
5. Tescott to New Cambria
6. Shipton vicinity



Reaches

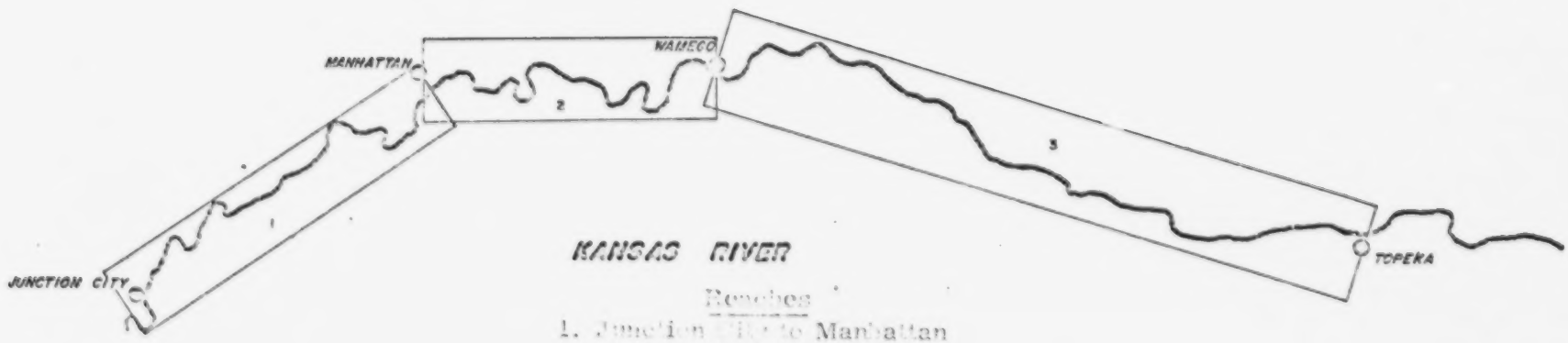
1. Beloit to Asherville
2. Beloit to Glasco
3. Glasco to Minneapolis
4. Sunnyerville to Minneapolis
5. Minneapolis to Bennington
6. Minneapolis to Solomon
7. Niles to Solomon
8. Niles vicinity



SMOKY HILL RIVER

Reaches

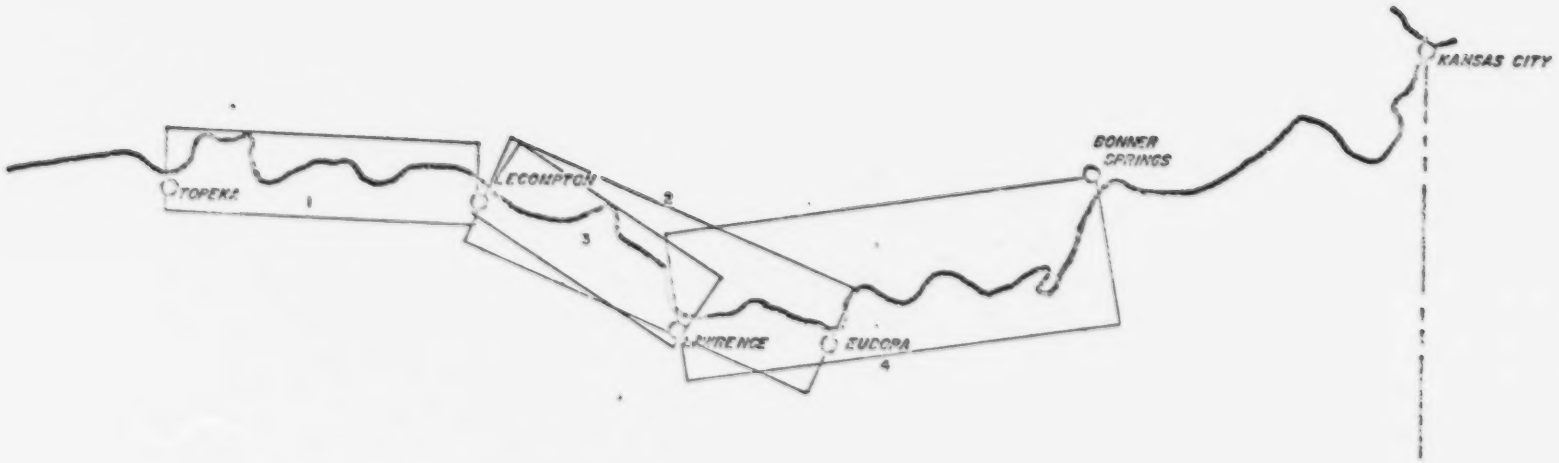
1. Kanopolis to Lindsborg
2. Lindsborg to Salina
3. Salina to Abilene
4. Salina to Solomon
5. Abilene to Junction City
6. Abilene to Chapman



KANSAS RIVER

Reaches

1. Junction City to Manhattan
2. Manhattan to Wamego
3. Wamego to Topeka



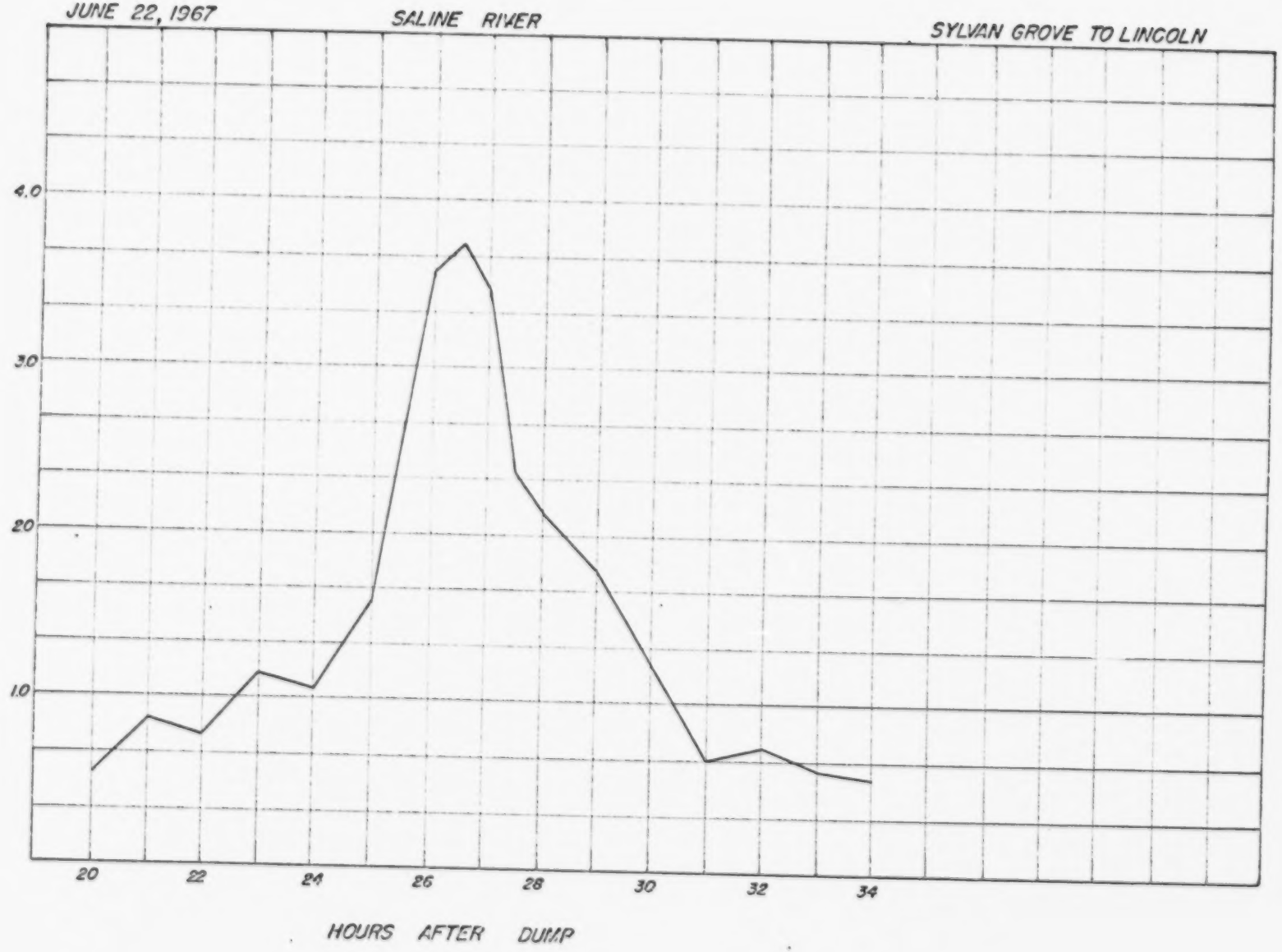
Reaches

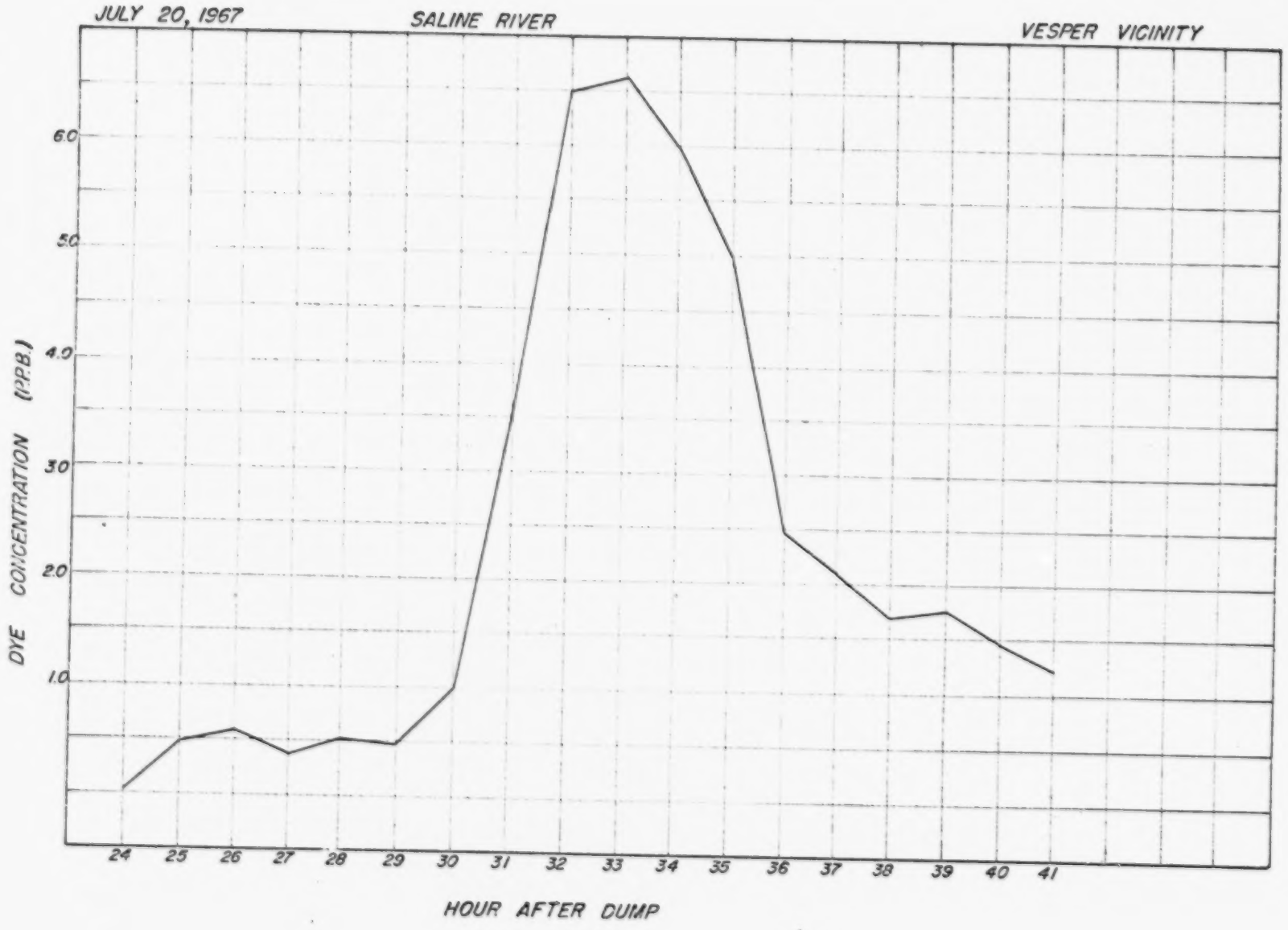
1. Topeka to Lecompton
2. Lecompton to Eudora
3. Lecompton to Lawrence
4. Lawrence to Bonner Springs

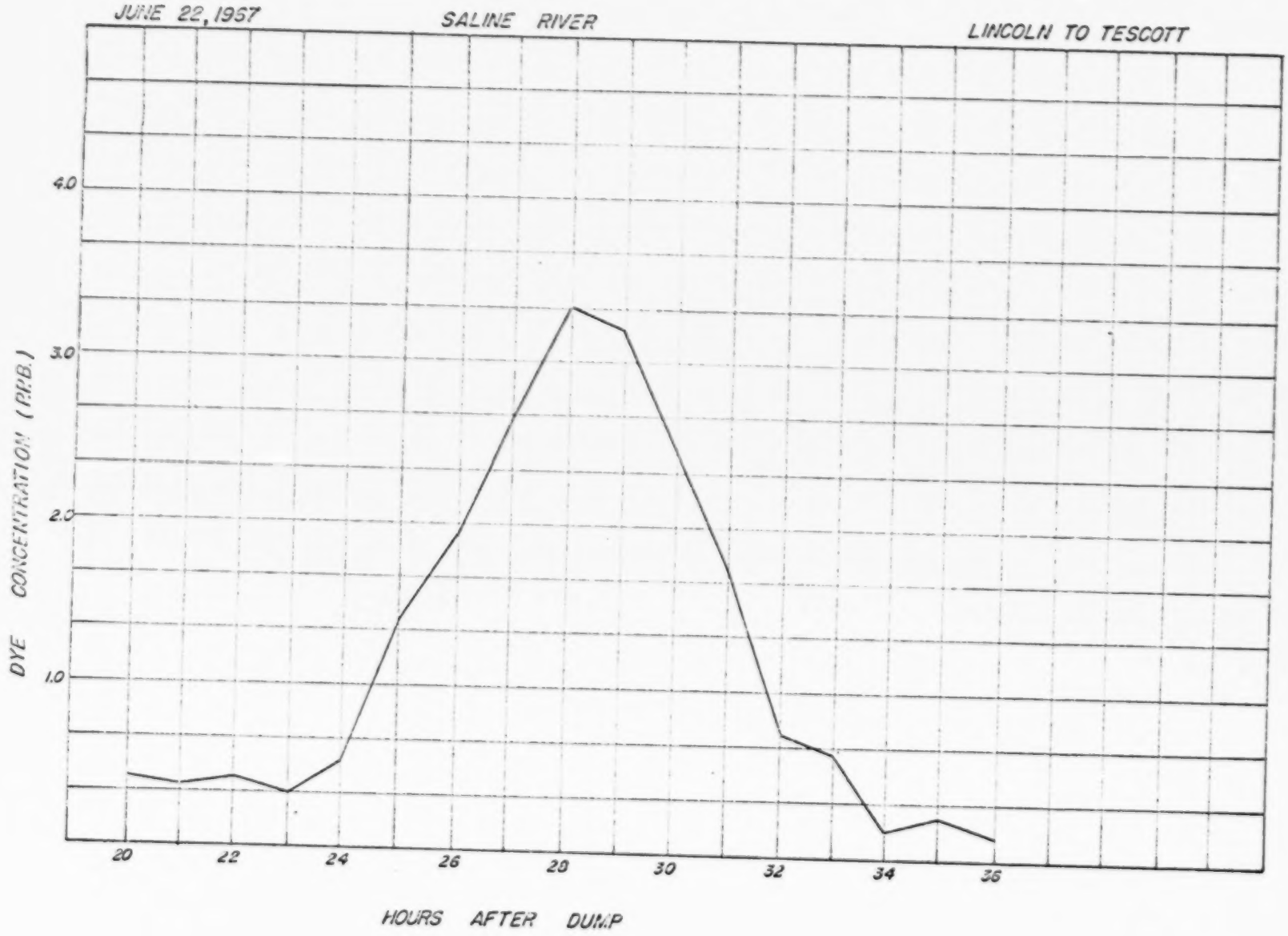
KANSAS RIVER

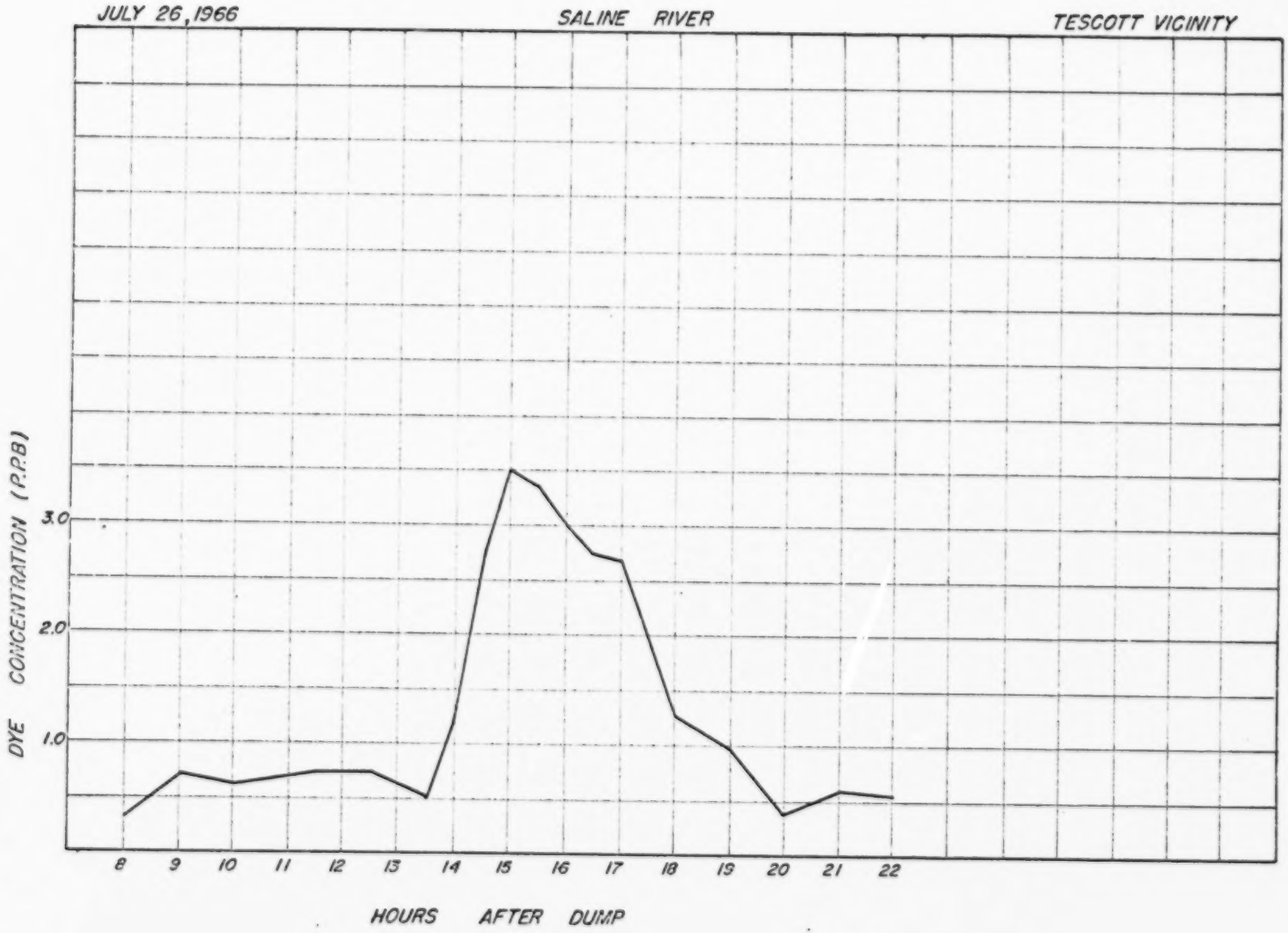
DYE STUDY RECOVERY CURVES

KANSAS RIVER SURVEY

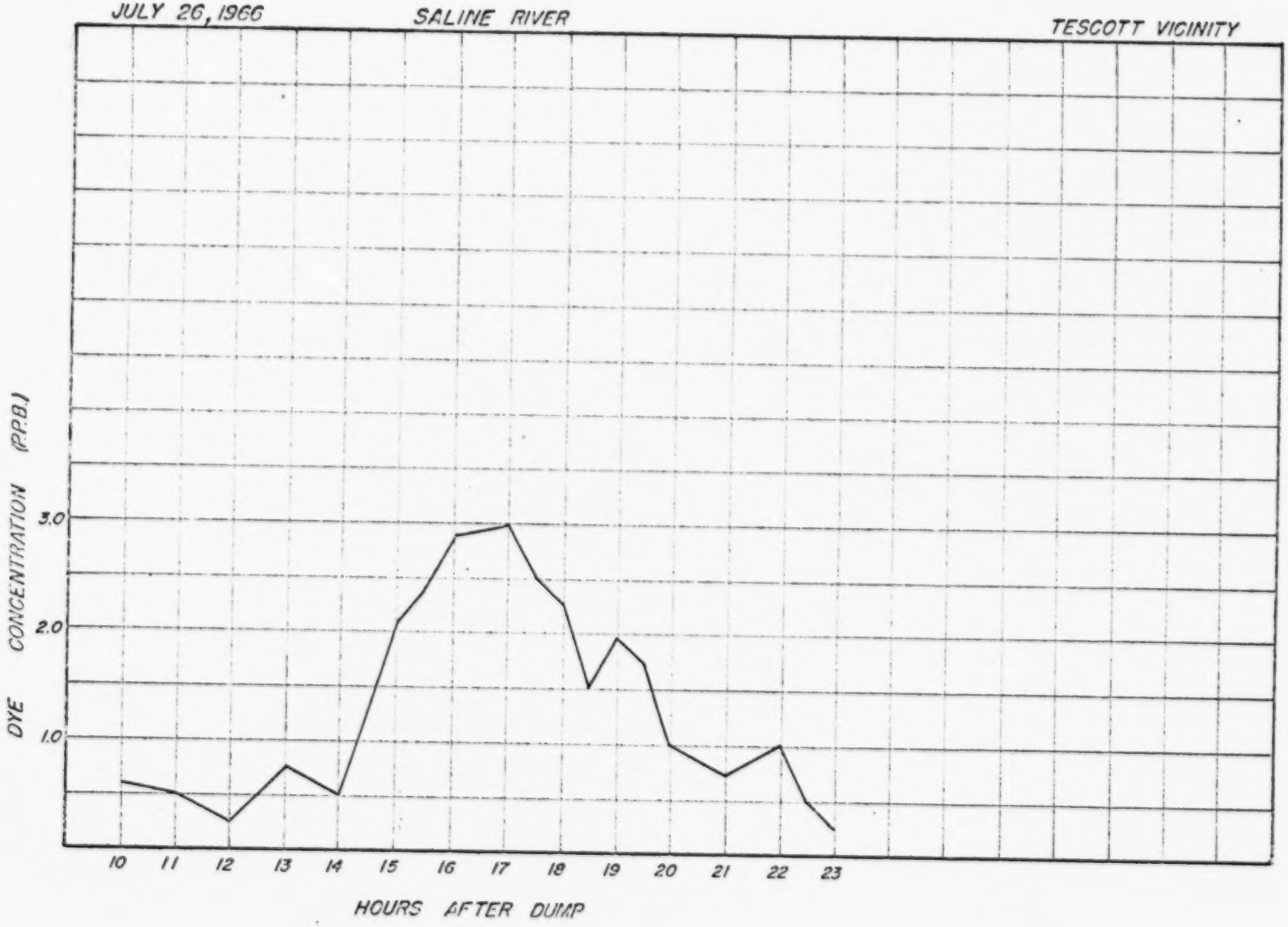

JUNE 22, 1967
SALINE RIVER
SYLVAN GROVE TO LINCOLN
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
20
22
24
26
28
30
32
34
HOURS AFTER DUMP

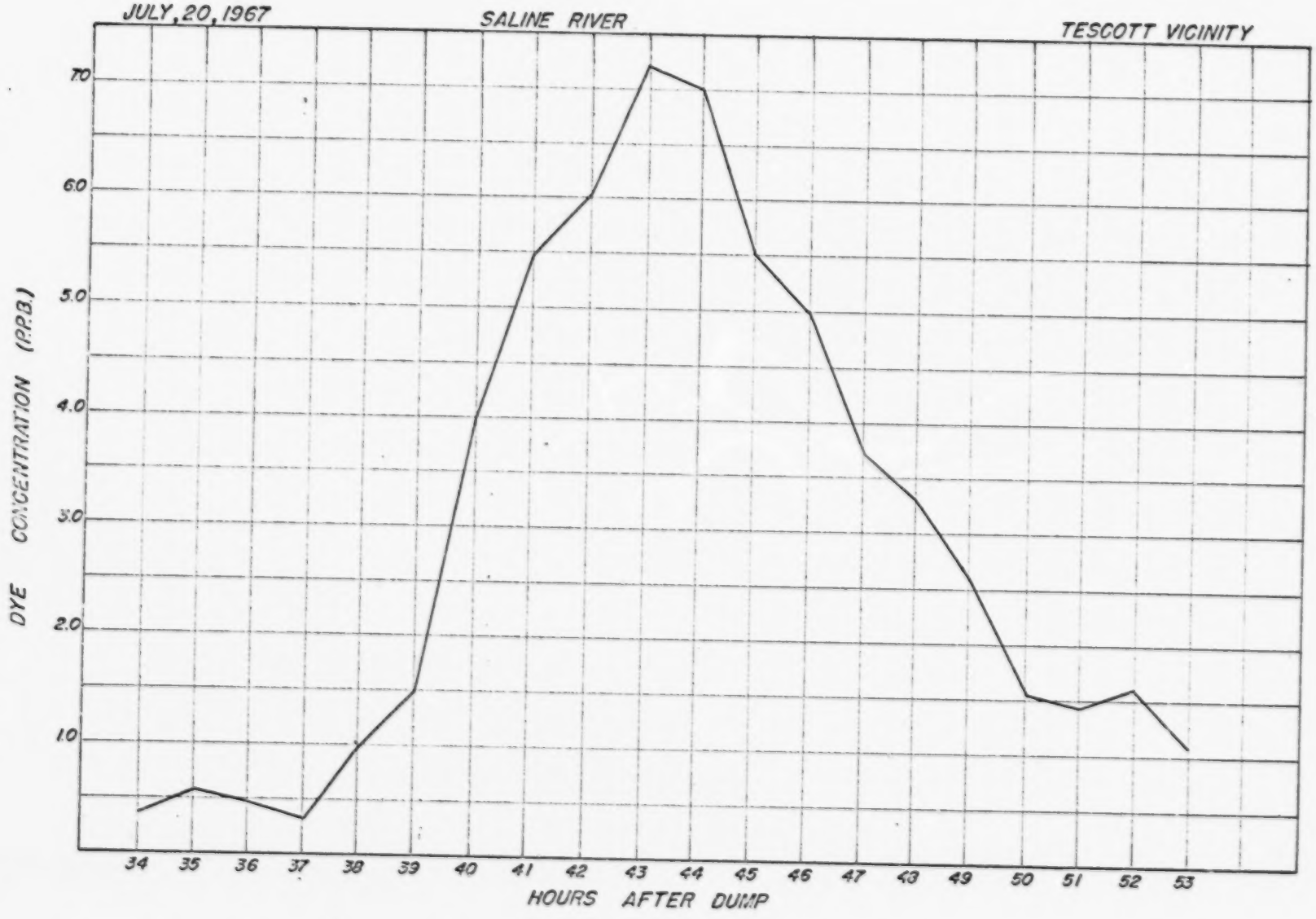

JULY 20, 1967
SALINE RIVER
VESPER VICINITY
DYE CONCENTRATION (P.P.B.)
6.0
5.0
4.0
3.0
2.0
1.0
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
HOUR AFTER DUMP

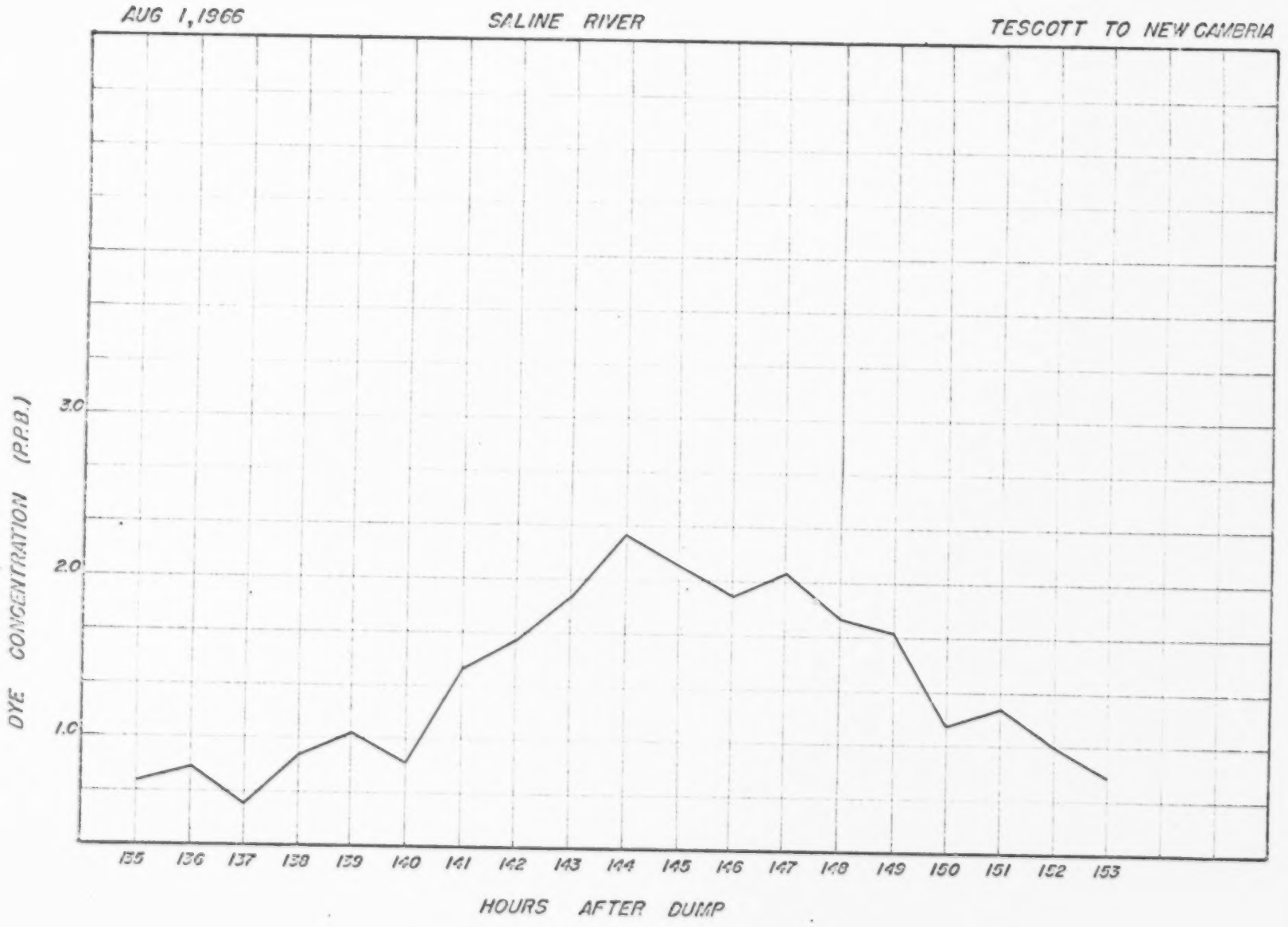

JUNE 22, 1957
SALINE RIVER
LINCOLN TO TESCOTT
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
20
22
24
26
28
30
32
34
36
HOURS AFTER DUMP

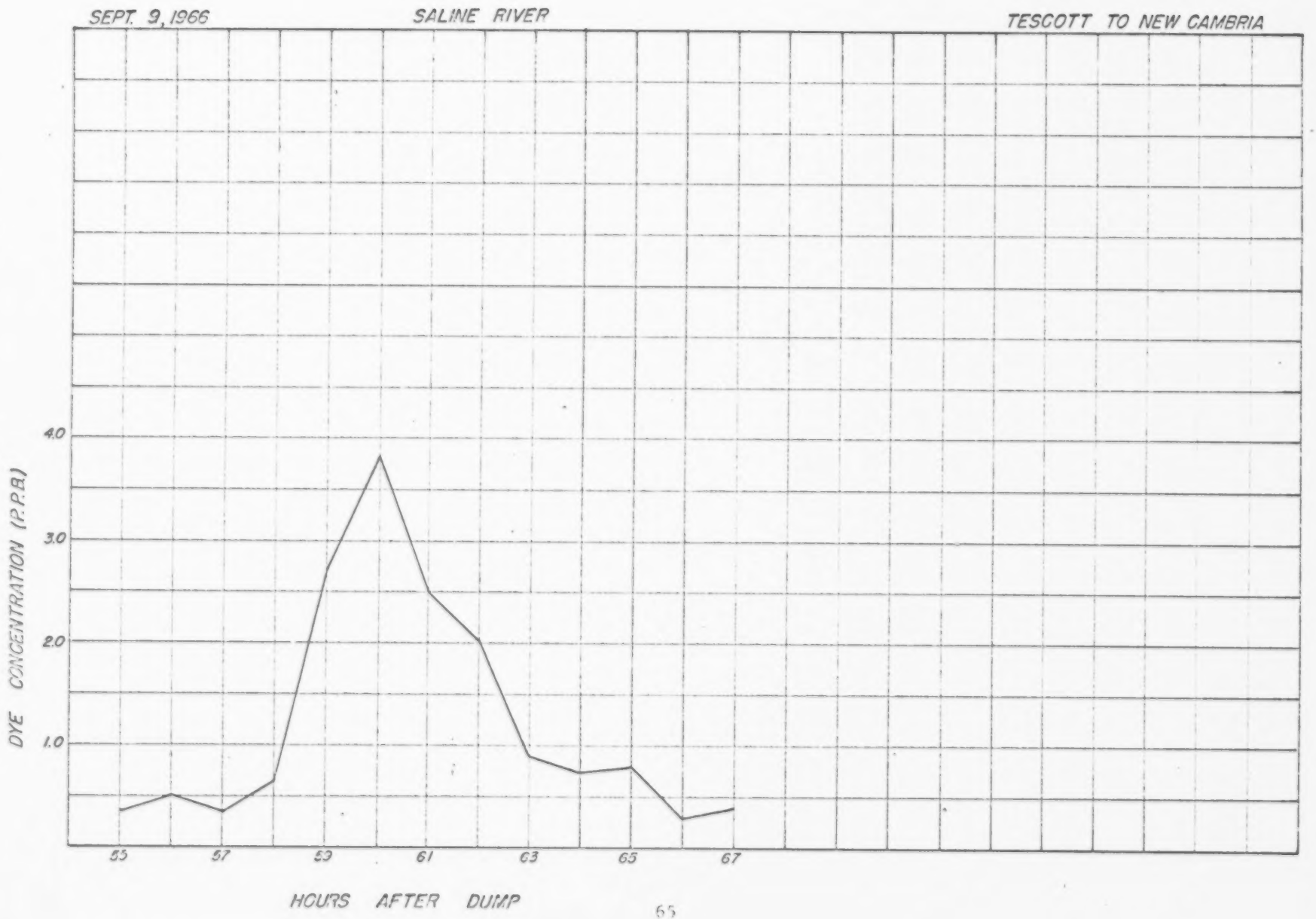

JULY 26, 1966
SALINE RIVER
TESCOTT VICINITY
DYE CONCENTRATION (P.P.B)
3.0
2.0
1.0
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
HOURS AFTER DUMP

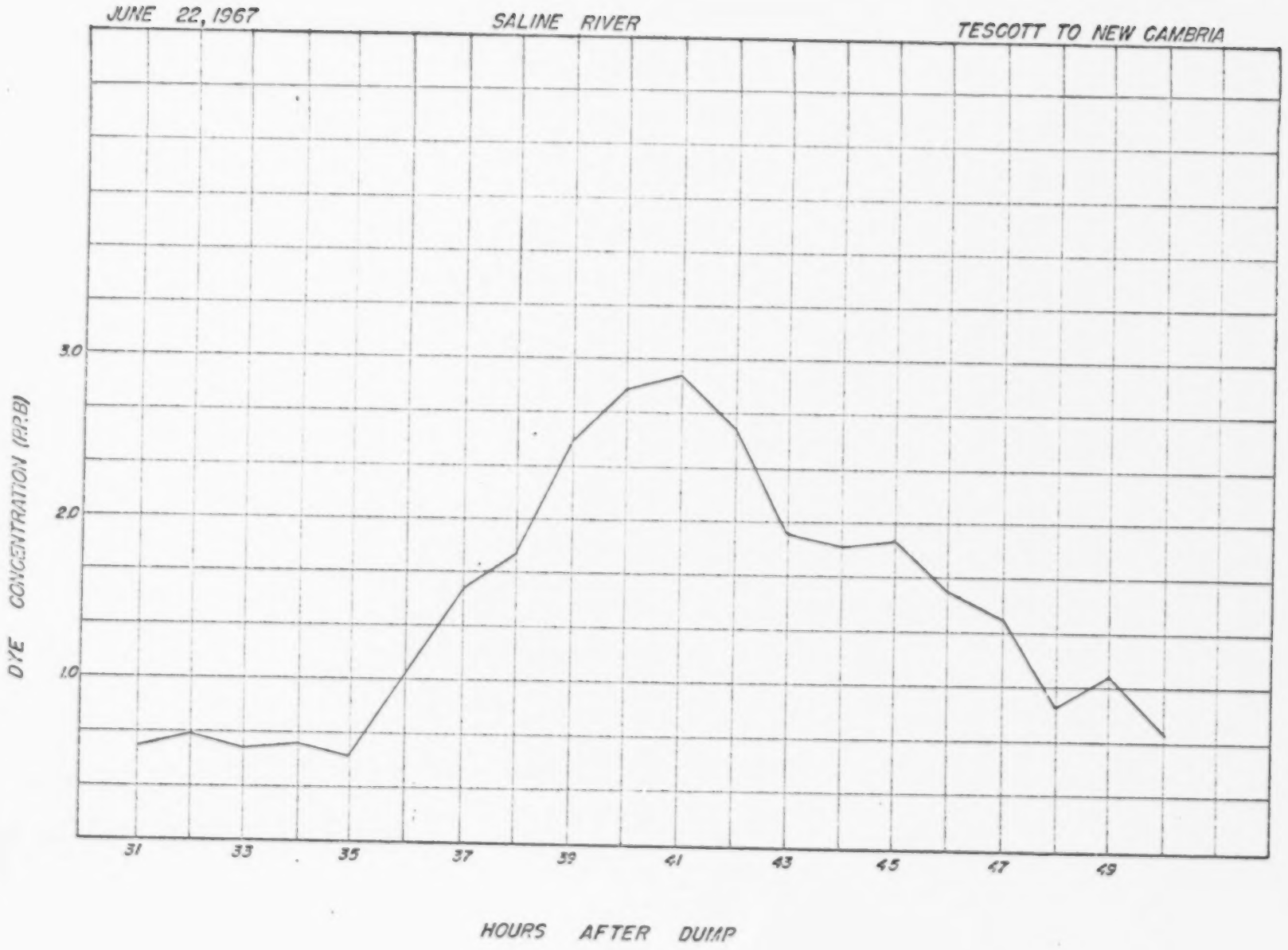
17

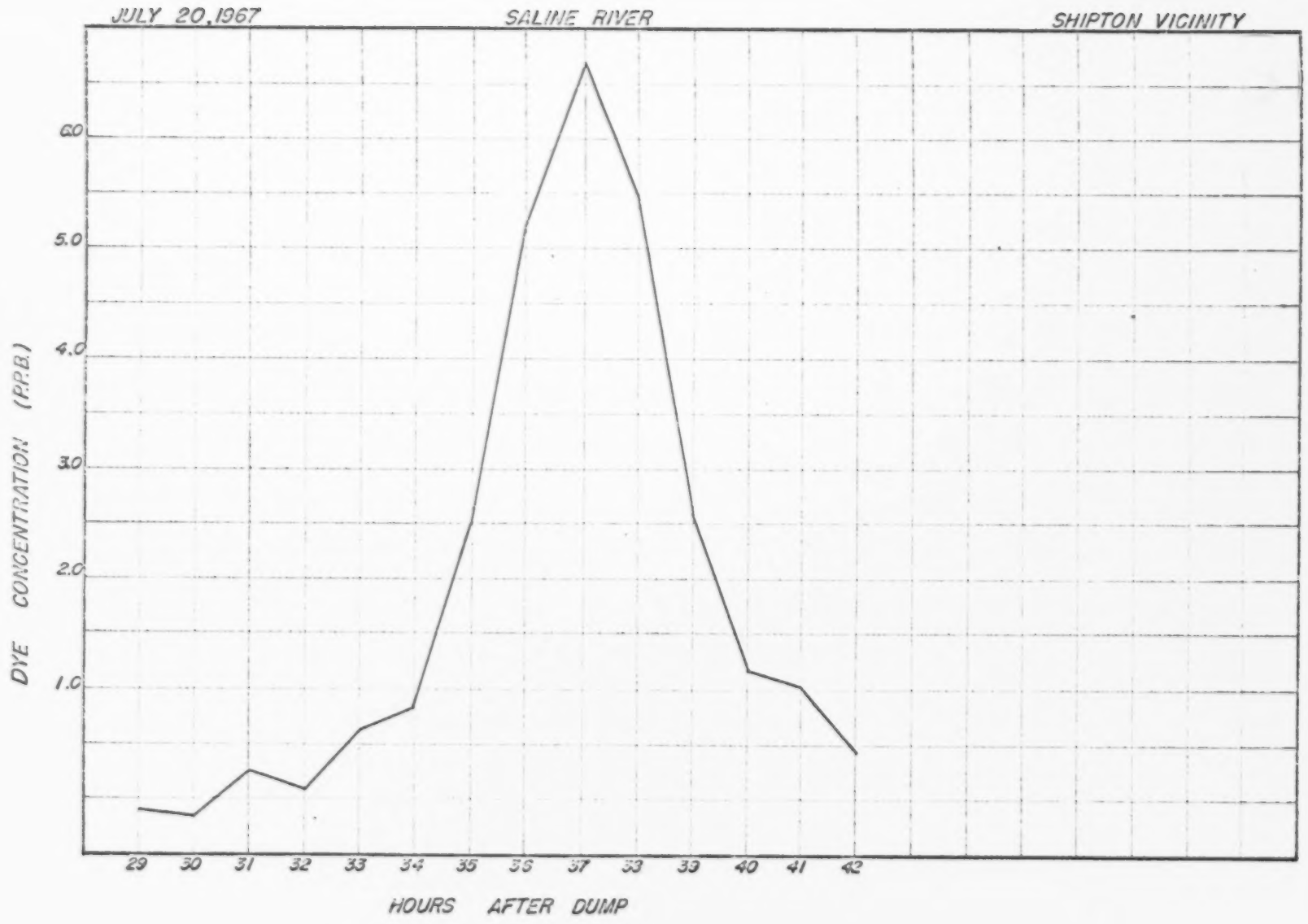

JULY 26, 1966
SALINE RIVER
TESCOTT VICINITY
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
10
11
12
13
14
15
16
17
18
19
20
21
22
23
HOURS AFTER DUMP

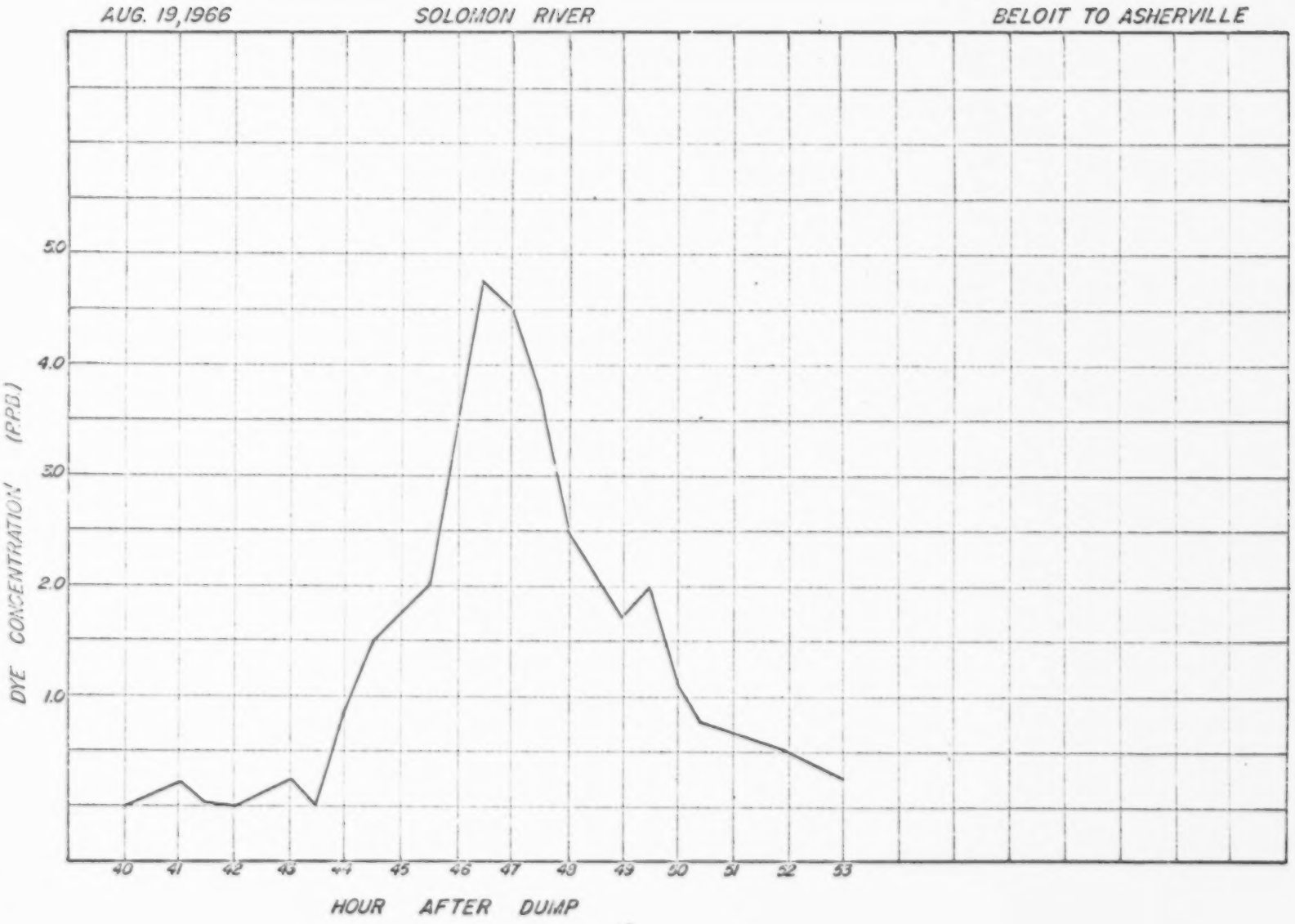

JULY, 20, 1967
SALINE RIVER
TESCOTT VICINITY
DYE CONCENTRATION (PPB.)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53
HOURS AFTER DUMP

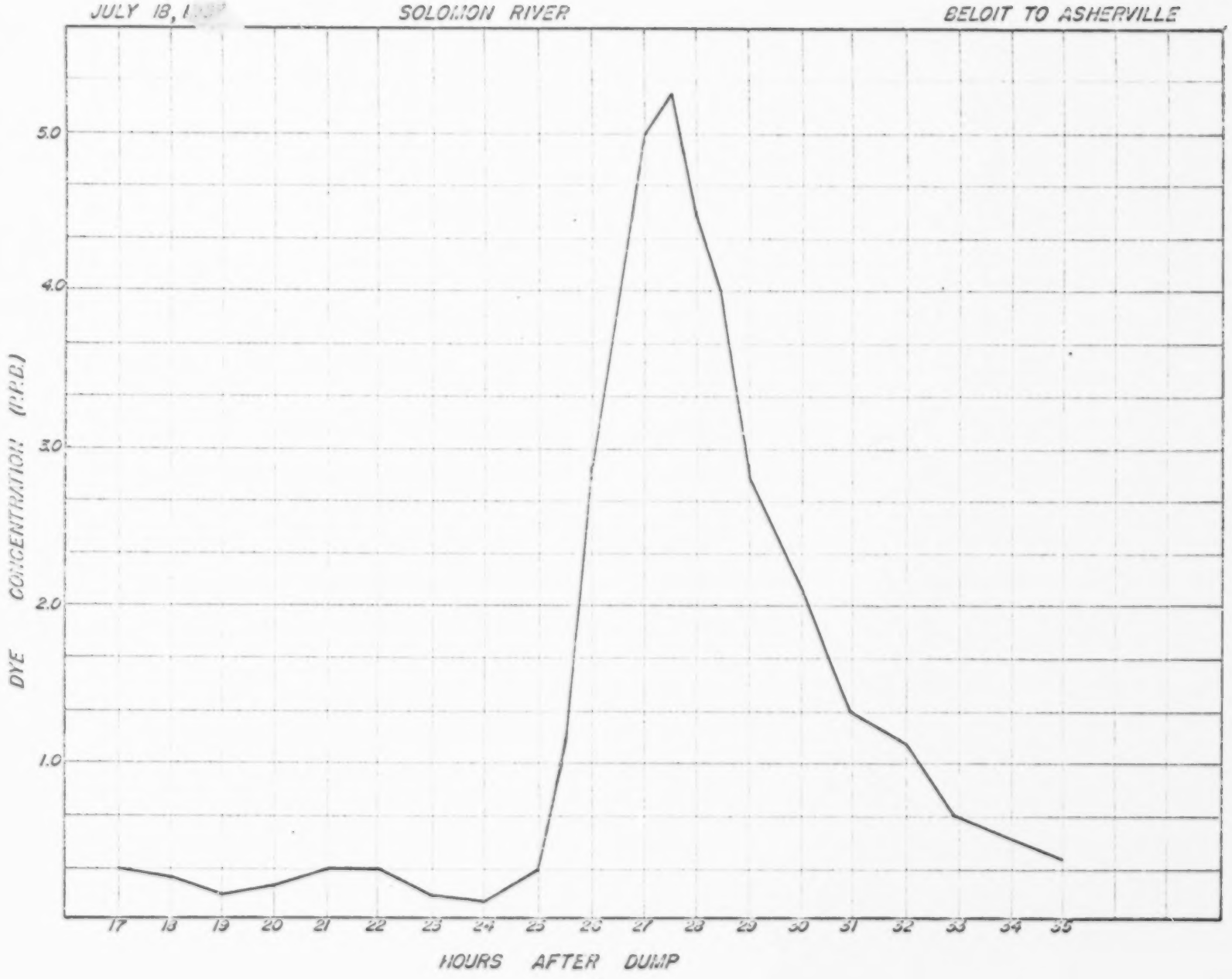

AUG 1, 1966
SALINE RIVER
TESCOTT TO NEW CAMBRIA
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153
HOURS AFTER DUMP

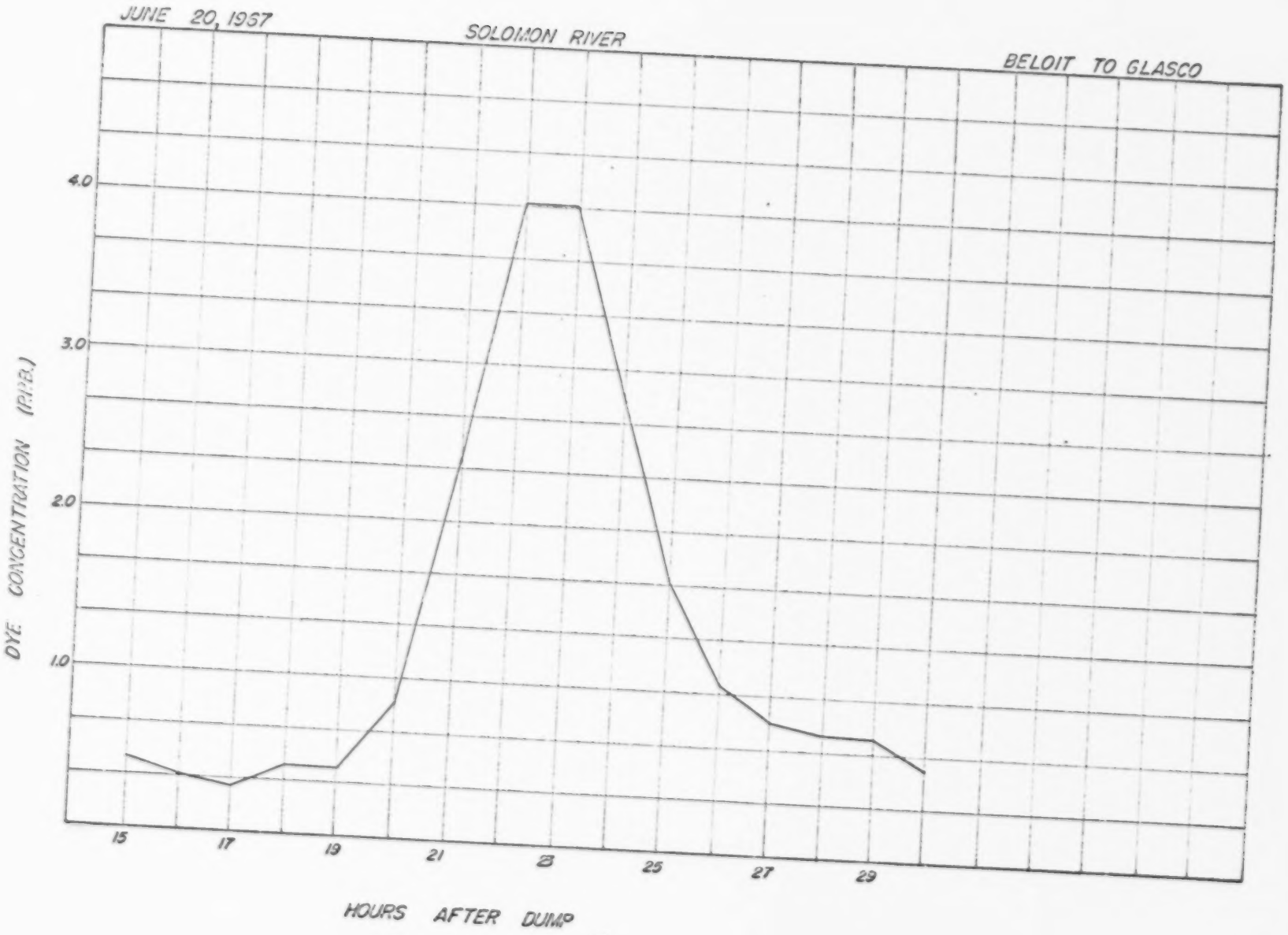

SEPT. 9, 1966
SALINE RIVER
TESCOTT TO NEW CAMBRIA
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
55
57
59
61
63
65
67
HOURS AFTER DUMP

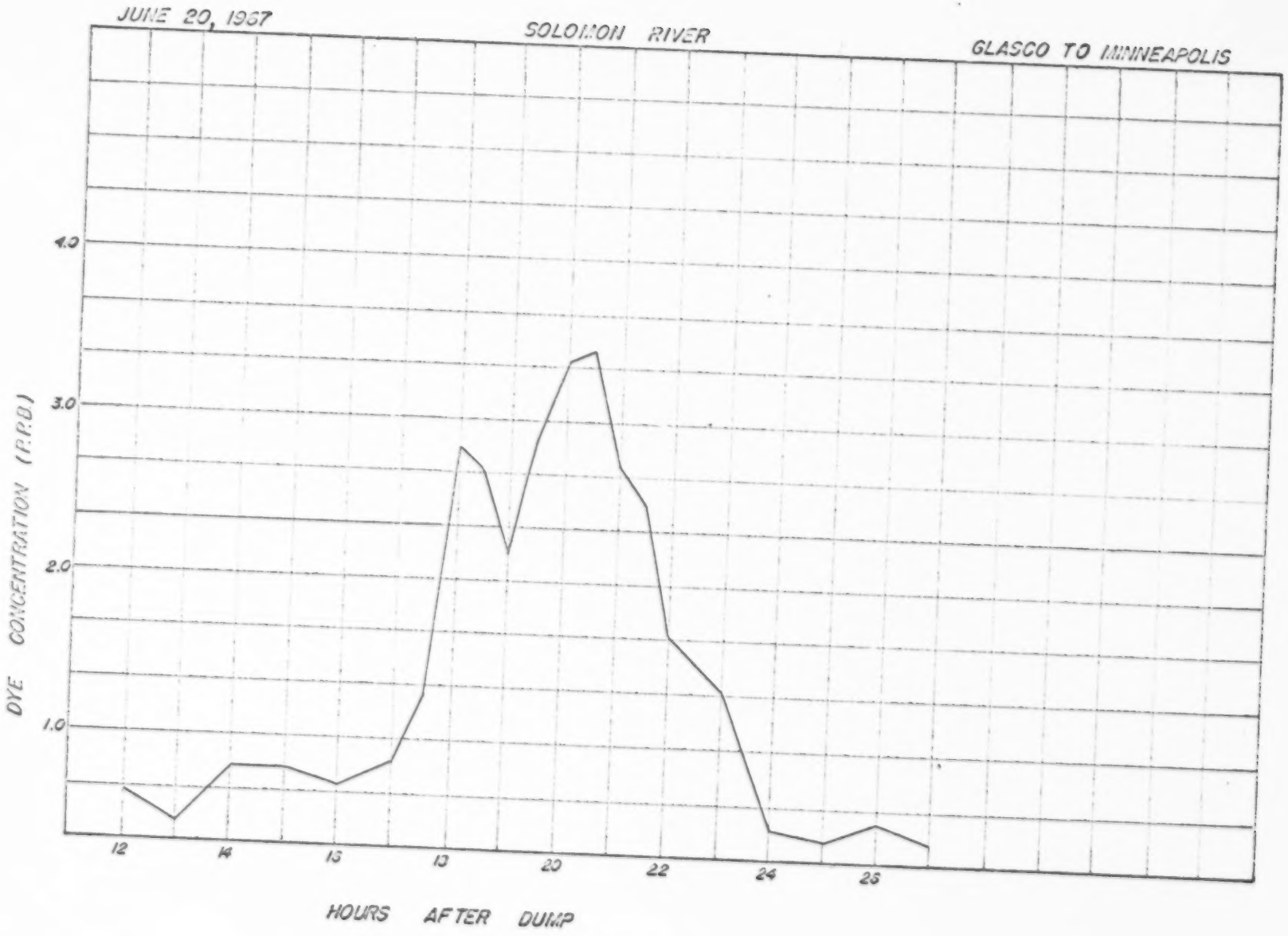

JUNE 22, 1967
SALINE RIVER
TESCOTT TO NEW CAMBRIA
DYE CONCENTRATION (P.P.B)
3.0
2.0
1.0
31
33
35
37
39
41
43
45
47
49
HOURS AFTER DUMP

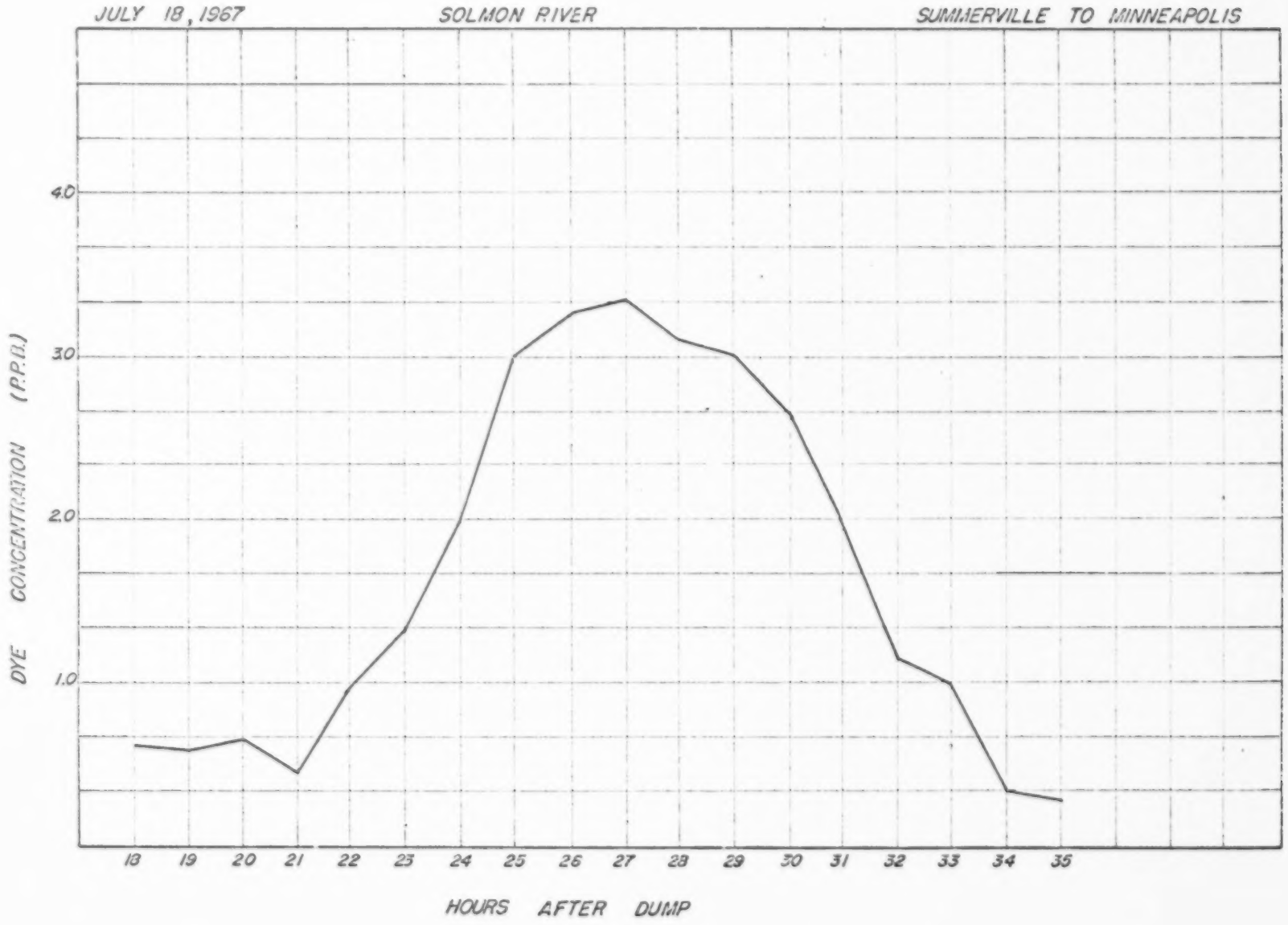

JULY 20, 1967
SALINE RIVER
SHIPTON VICINITY
DYE CONCENTRATION (P.P.B.)
6.0
5.0
4.0
3.0
2.0
1.0
29
30
31
32
33
34
35
36
37
38
39
40
41
42
HOURS AFTER DUMP

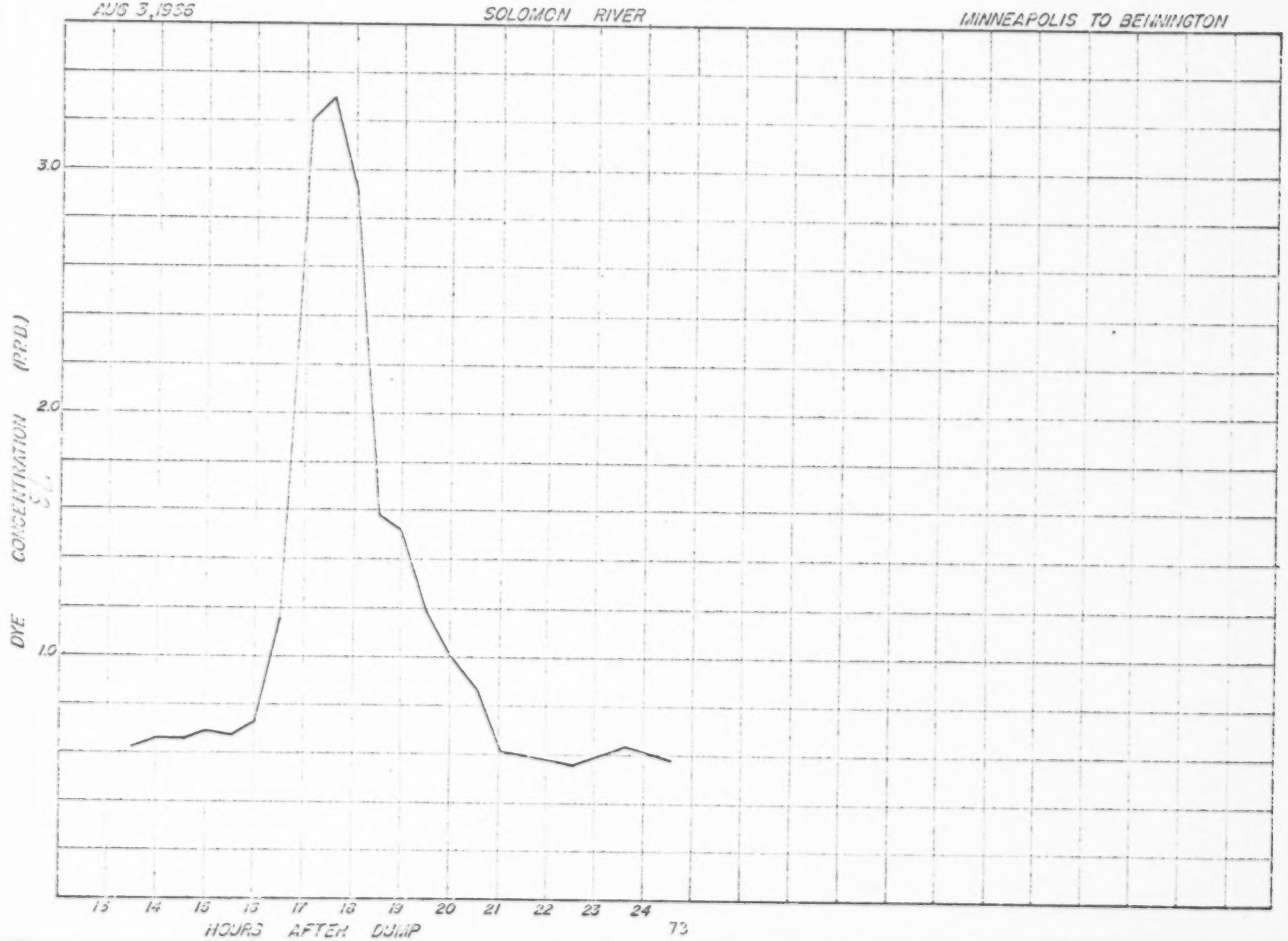

AUG. 19, 1966
SOLOMON RIVER
BELOIT TO ASHERVILLE
DYE CONCENTRATION (P.P.B.)
5.0
4.0
3.0
2.0
1.0
40
41
42
43
44
45
46
47
48
49
50
51
52
53
HOUR AFTER DUMP

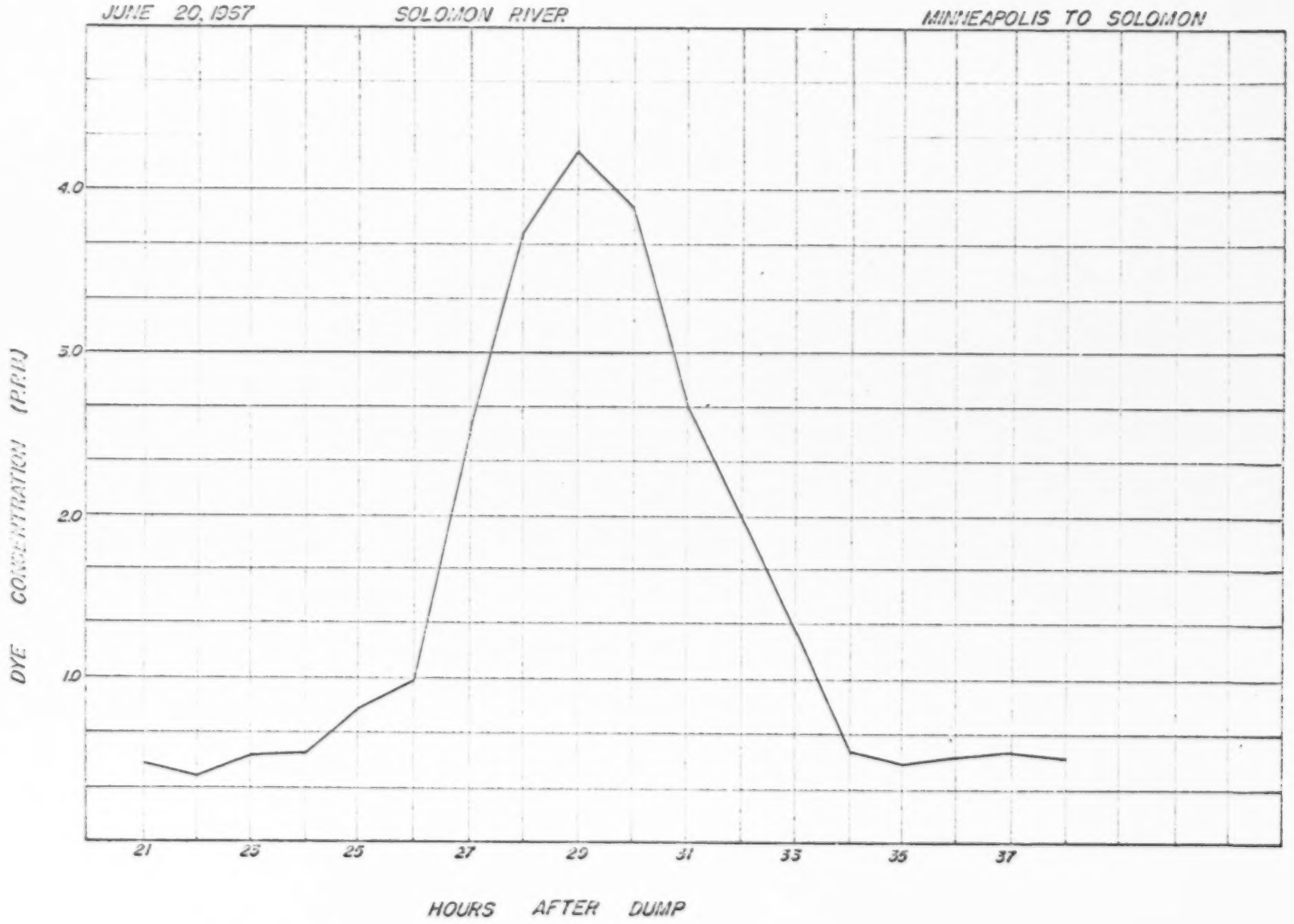

JULY 18,
SOLOMON RIVER
BELOIT TO ASHERVILLE
DYE CONCENTRATION (P.P.B.)
5.0
4.0
3.0
2.0
1.0
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
HOURS AFTER DUMP

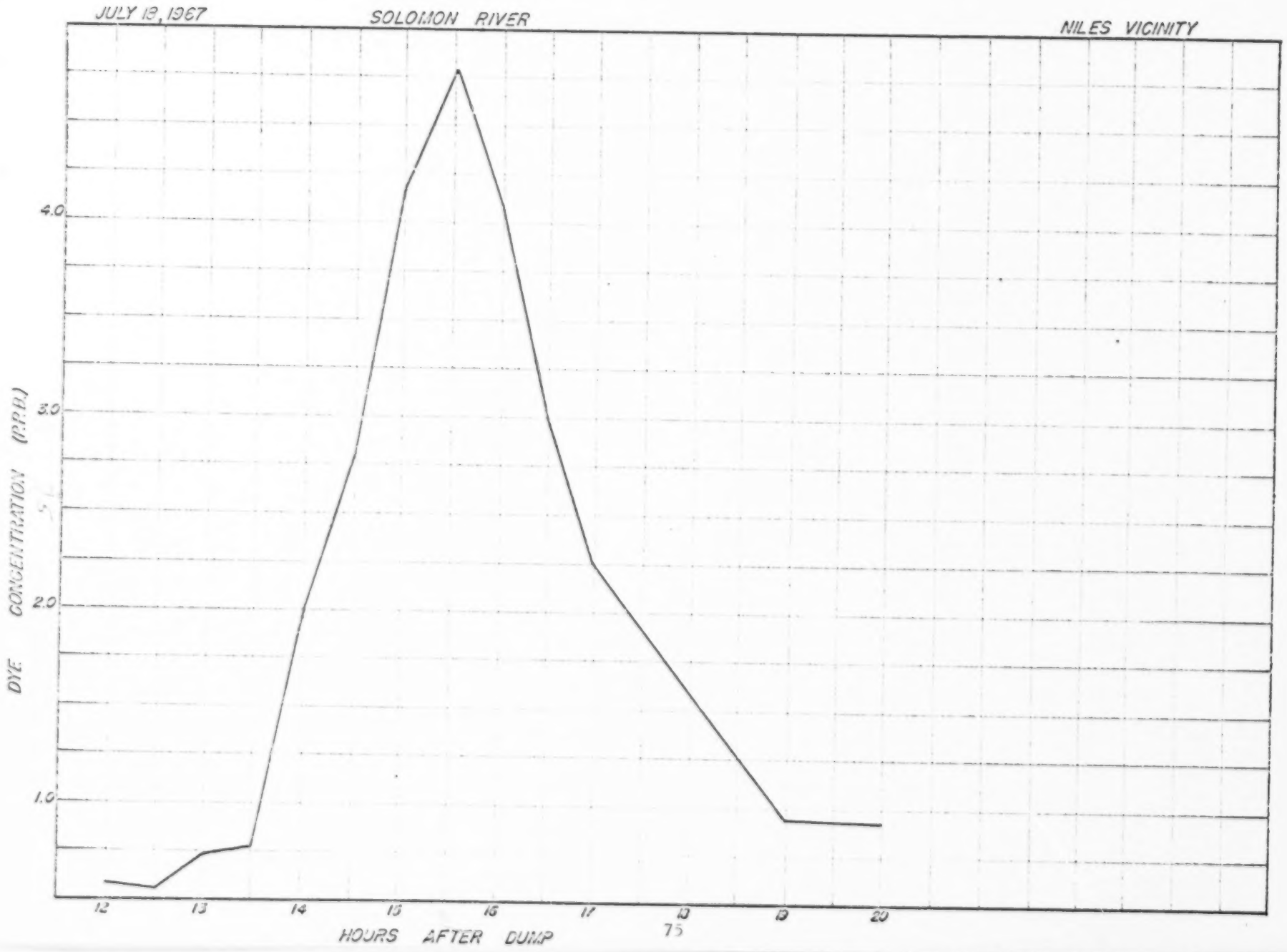

JUNE 20, 1957
SOLOMON RIVER
BELOIT TO GLASCO
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
15
17
19
21
23
25
27
29
HOURS AFTER DUMP

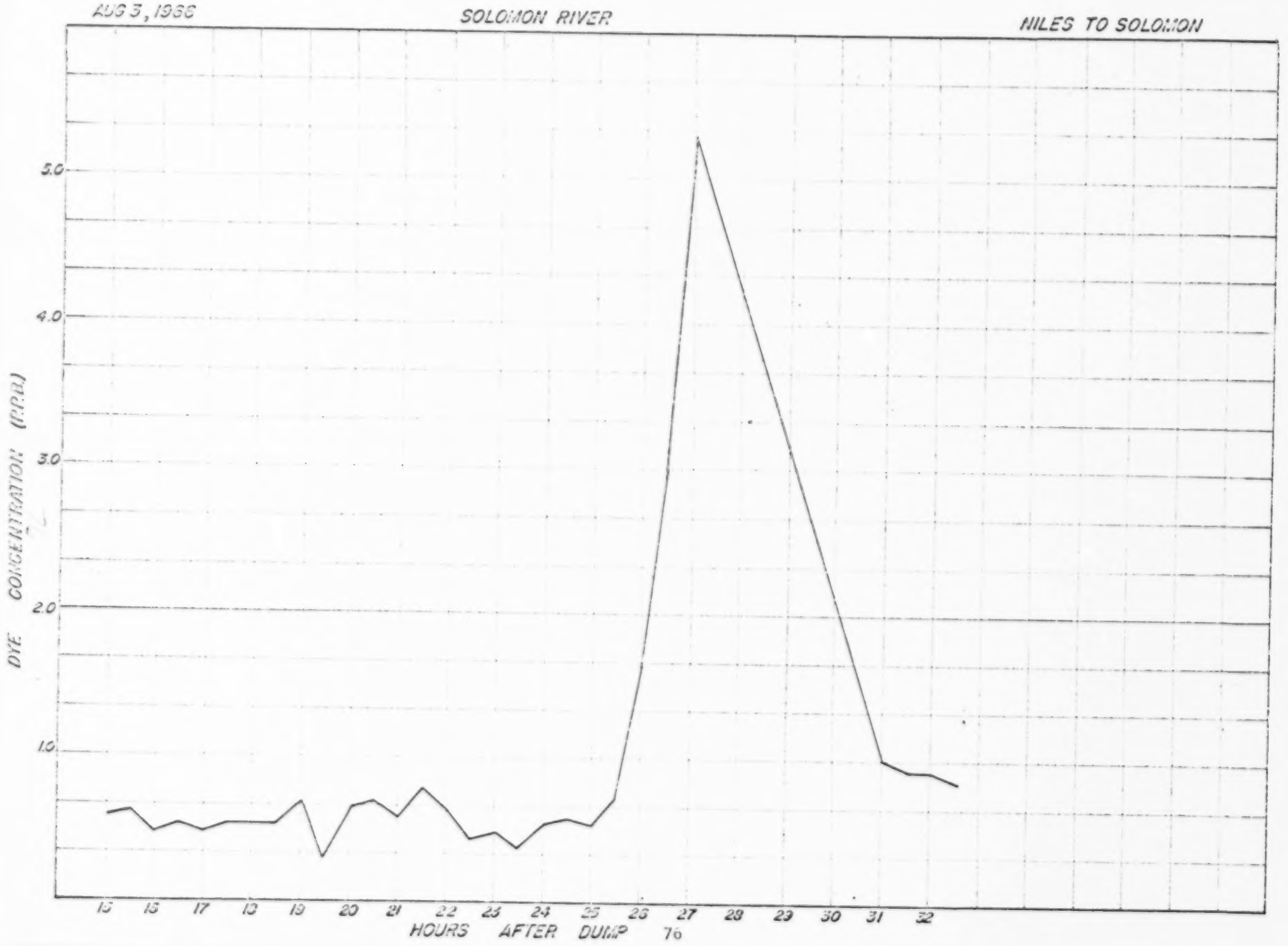

JUNE 20, 1967
SOLOMON RIVER
GLASCO TO MINNEAPOLIS
DYE CONCENTRATION (P.P.D.)
4.0
3.0
2.0
1.0
12
14
16
18
20
22
24
26
HOURS AFTER DUMP

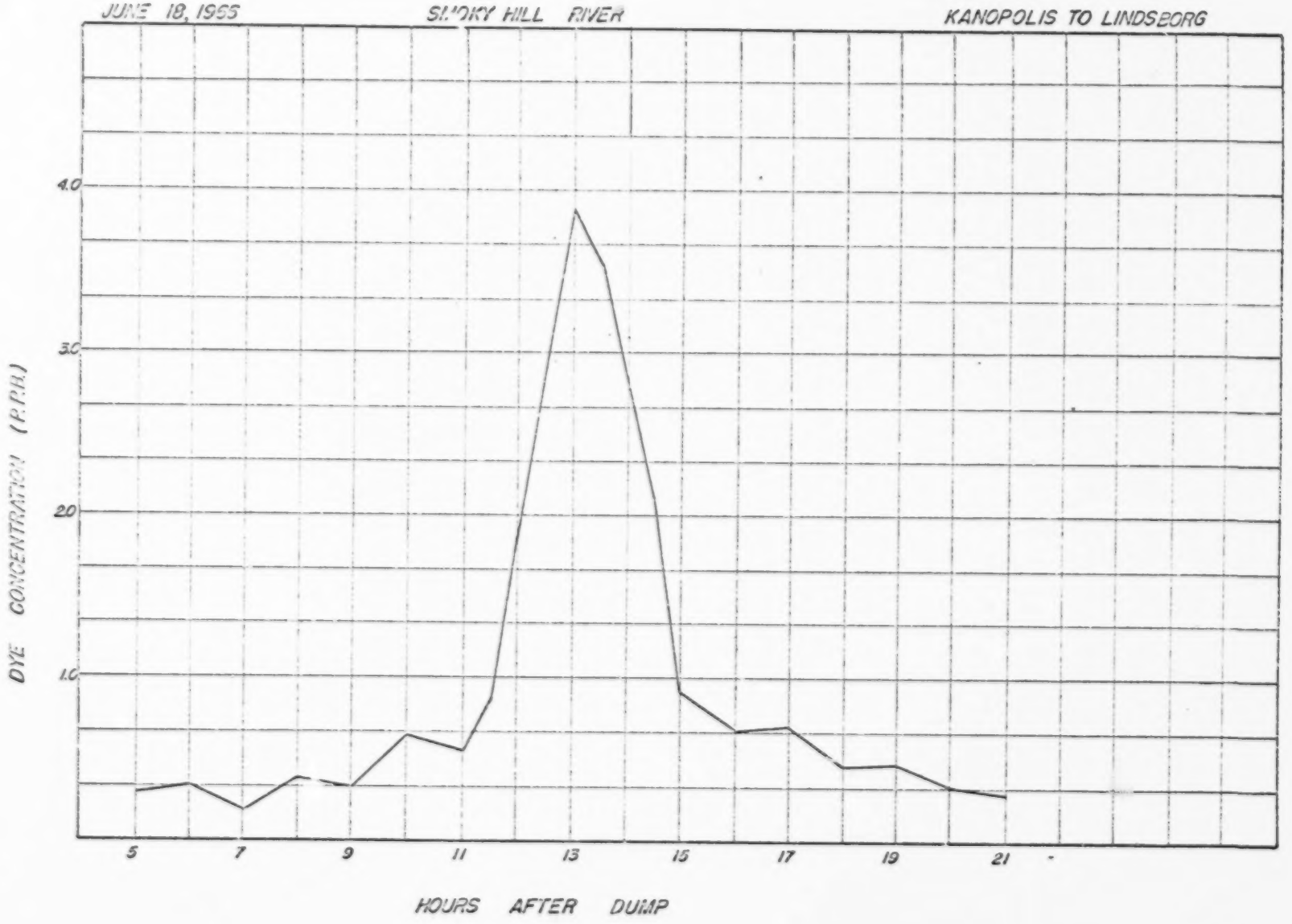

JULY 18, 1967
SOLMON RIVER
SUMMERVILLE TO MINNEAPOLIS
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
HOURS AFTER DUMP

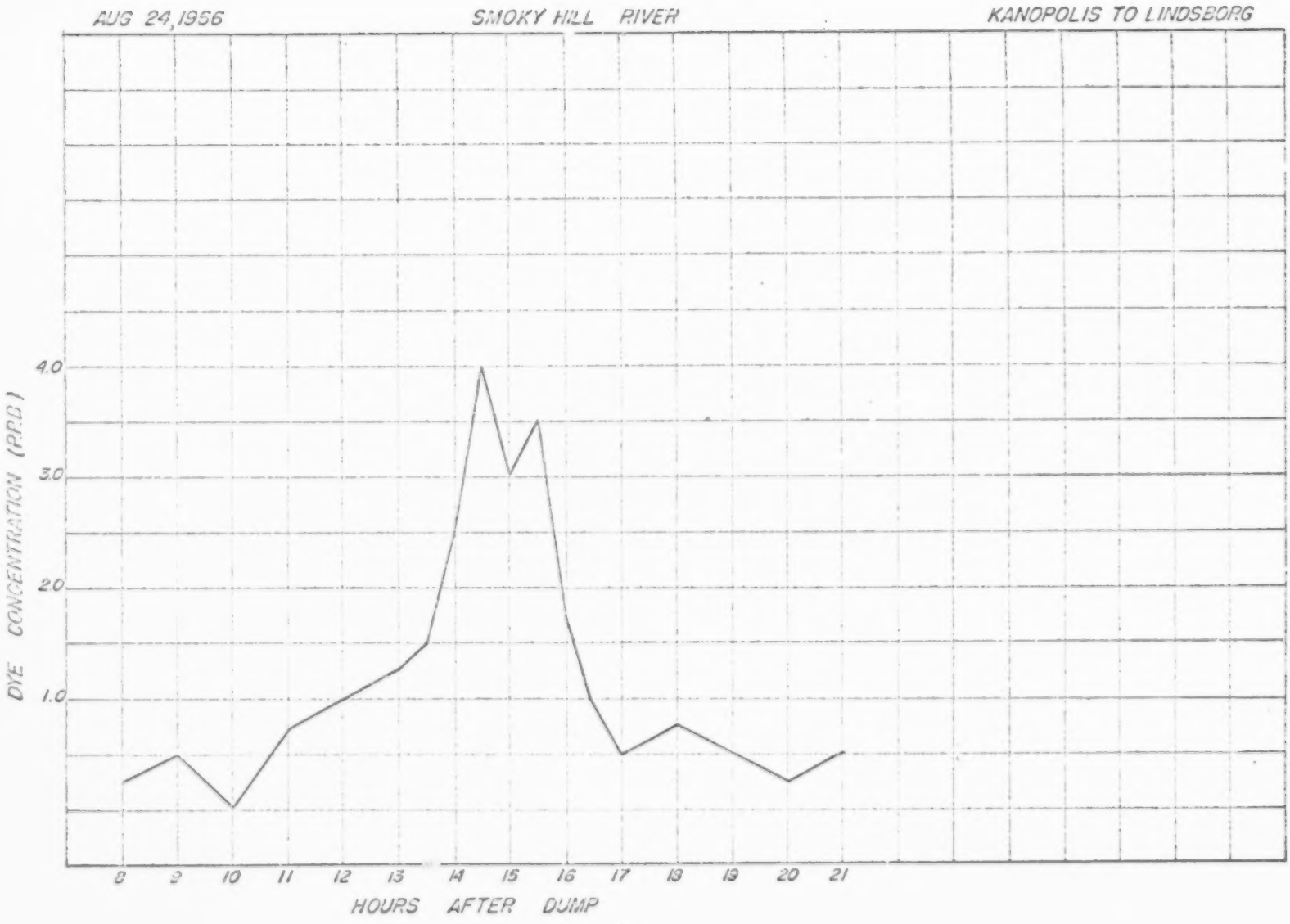

AUG 3, 1936
SOLOMON RIVER
MINNEAPOLIS TO BENNINGTON
3.0
2.0
1.0
DYE CONCENTRATION (P.P.D.)
13
14
15
16
17
18
19
20
21
22
23
24
HOURS AFTER DUMP

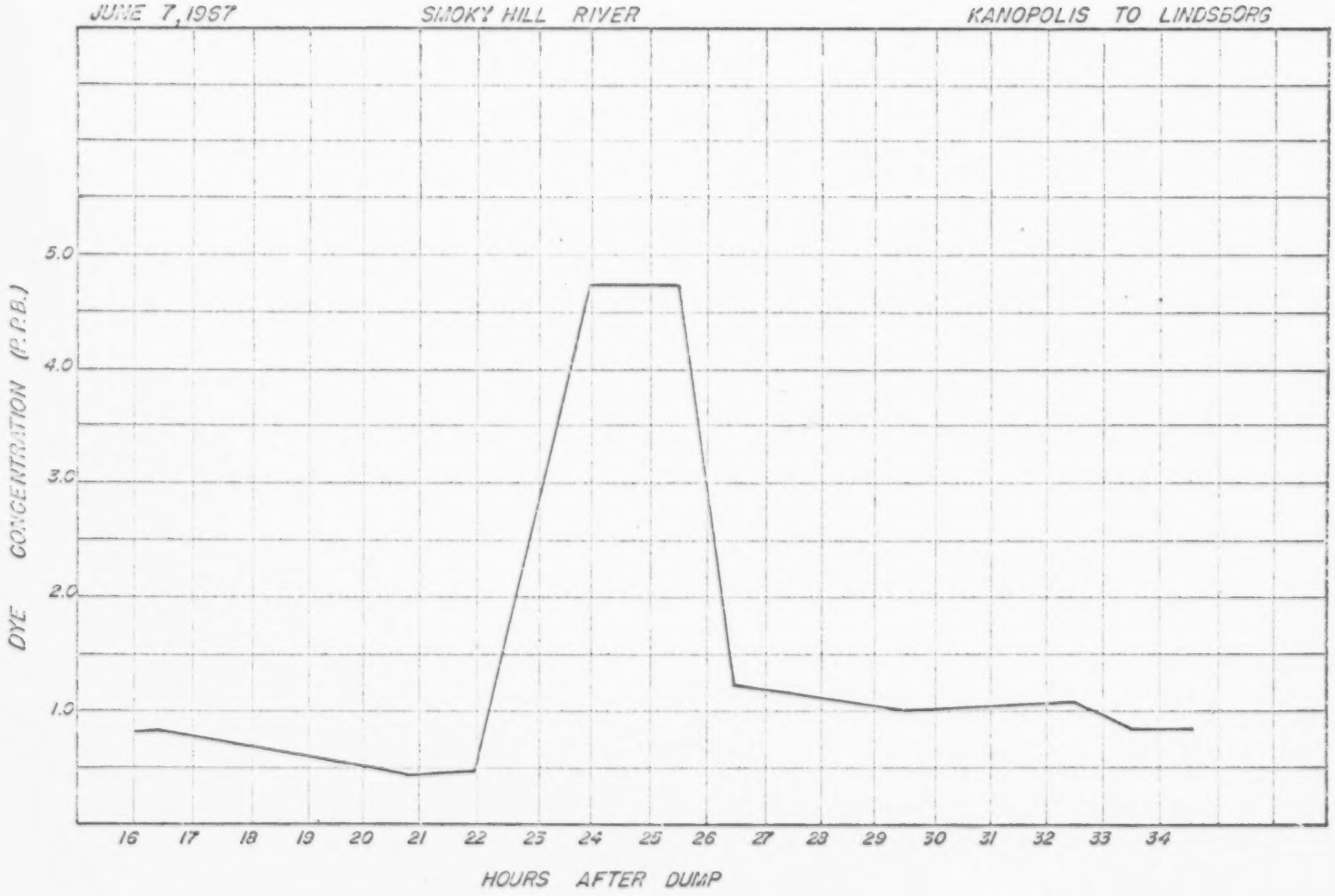

JUNE 20, 1957
SOLOMON RIVER
MINNEAPOLIS TO SOLOMON
DYE CONCENTRATION (P.P.M.)
4.0
3.0
2.0
1.0
21
23
25
27
29
31
33
35
37
HOURS AFTER DUMP

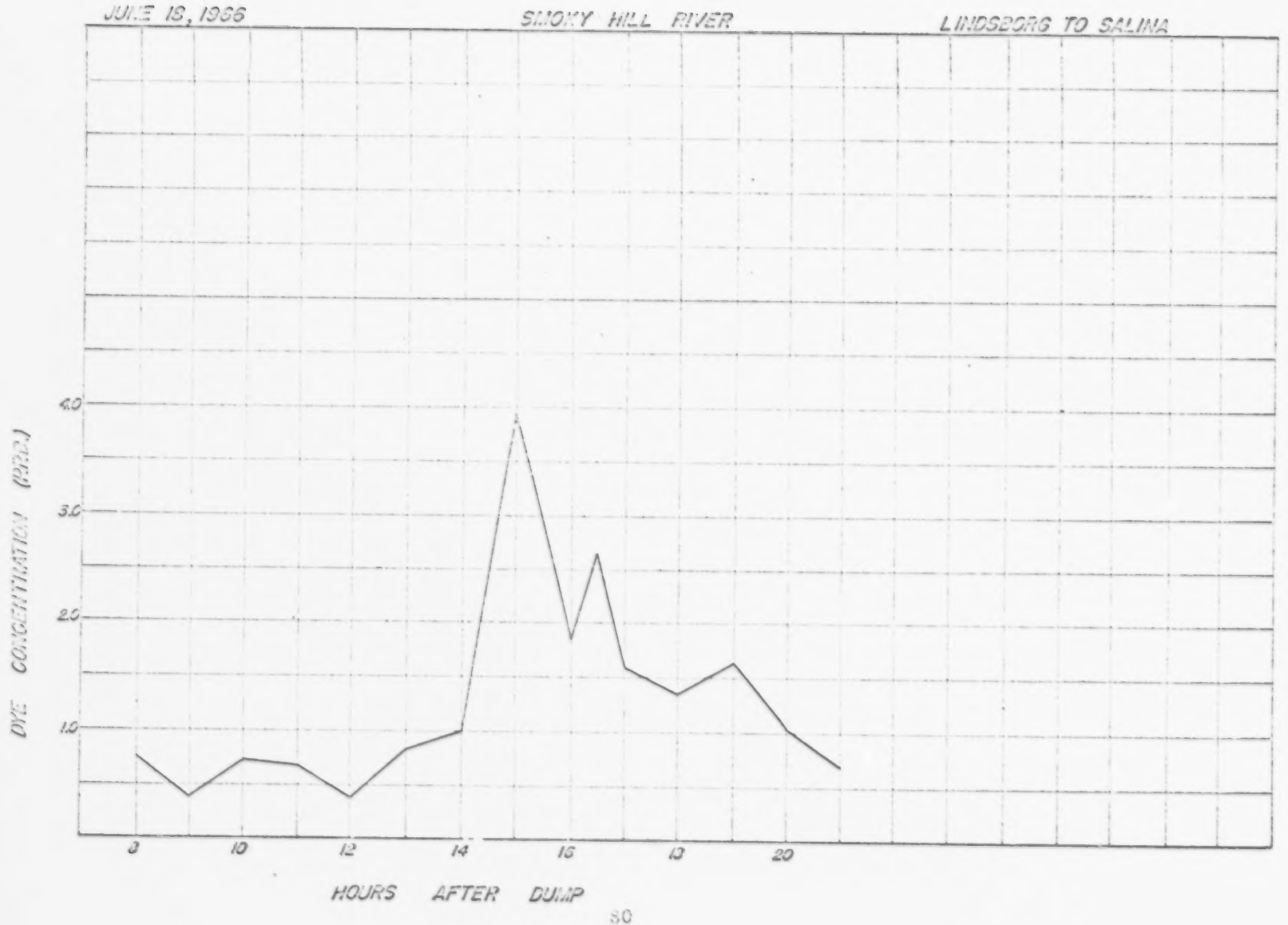

JULY 13, 1967
SOLOMON RIVER
NILES VICINITY
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
12
13
14
15
16
17
18
19
20
HOURS AFTER DUMP

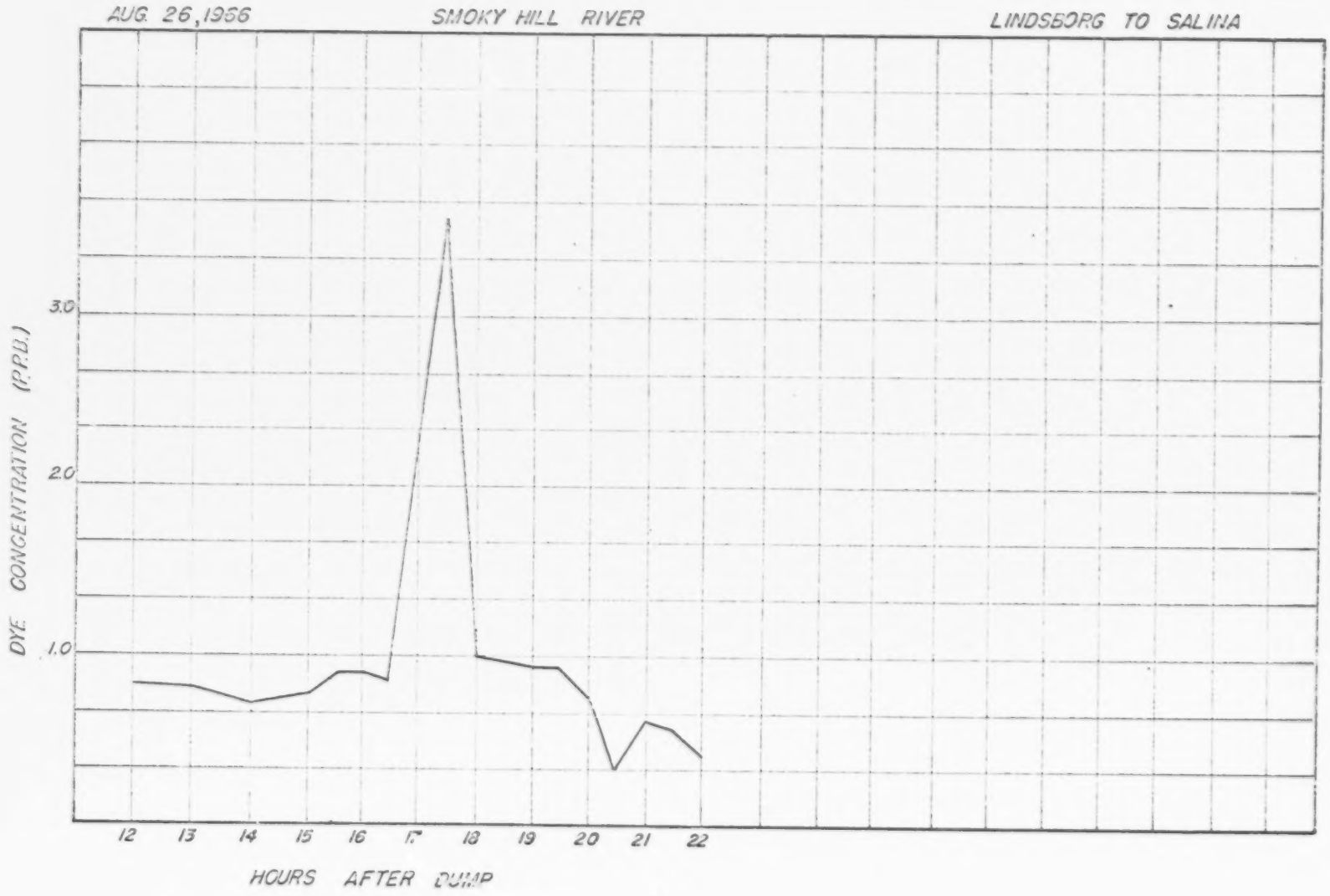

AUG 3, 1966
SOLOMON RIVER
NILES TO SOLOMON
DYE CONCENTRATION (P.P.M.)
5.0
4.0
3.0
2.0
1.0
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
HOURS AFTER DUMP
76

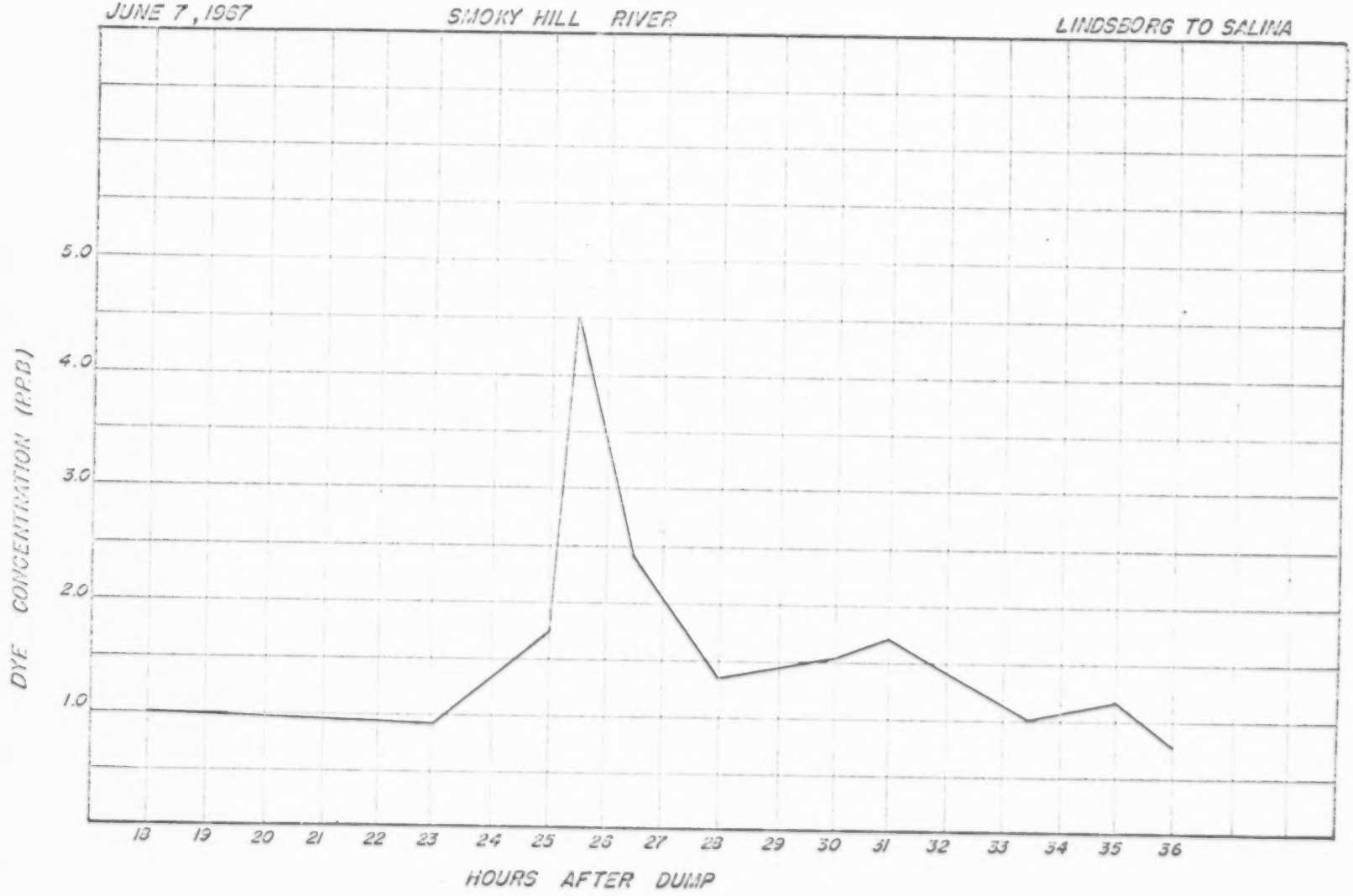

JUNE 18, 1955
SMOKY HILL RIVER
KANOPOLIS TO LINDSBORG
DYE CONCENTRATION (P.P.M.)
4.0
3.0
2.0
1.0
5
7
9
11
13
15
17
19
21
HOURS AFTER DUMP

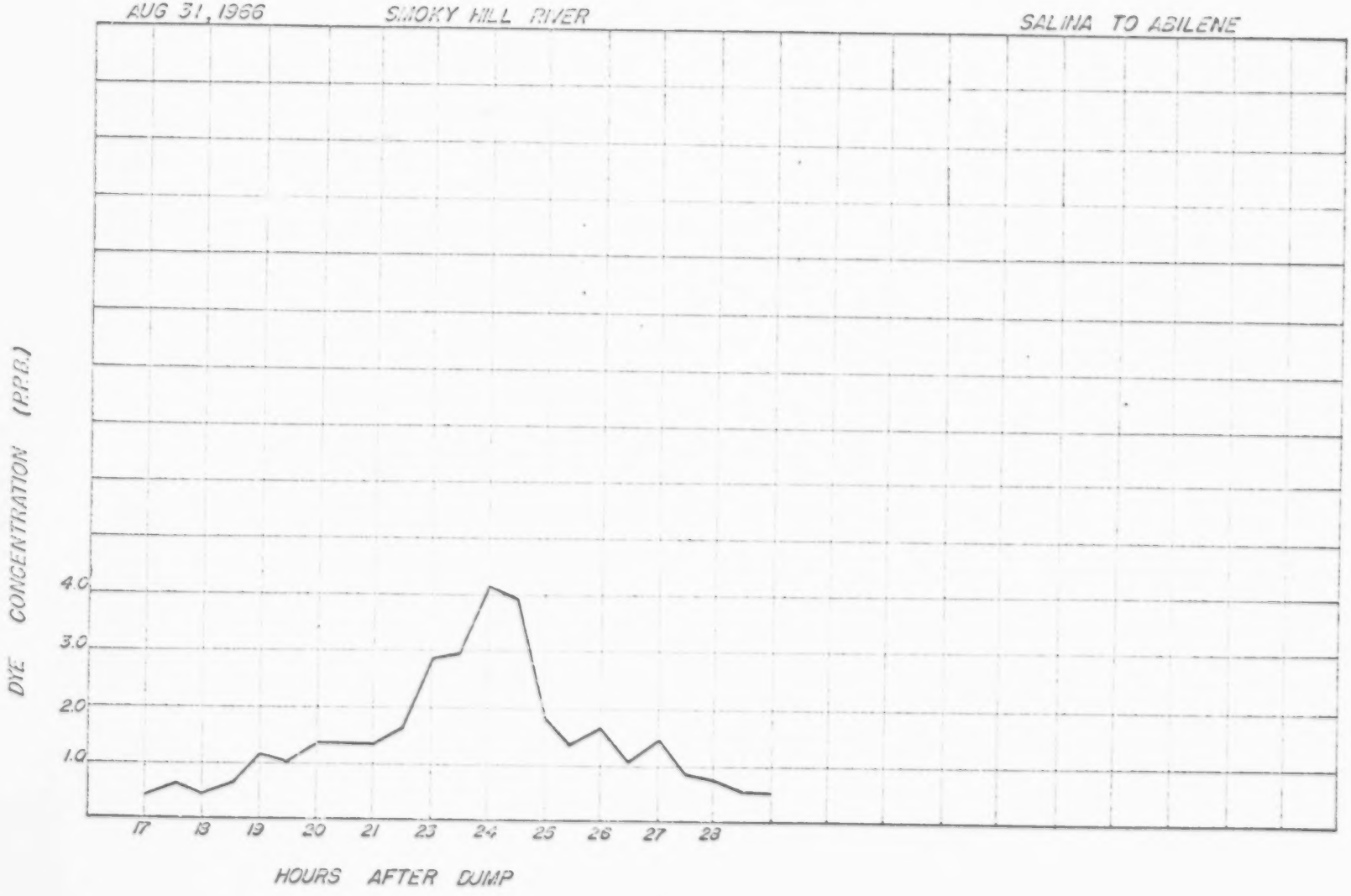

AUG 24, 1956
SMOKY HILL RIVER
KANOPOLIS TO LINDSBORG
DYE CONCENTRATION (PPB)
4.0
3.0
2.0
1.0
8
9
10
11
12
13
14
15
16
17
18
19
20
21
HOURS AFTER DUMP

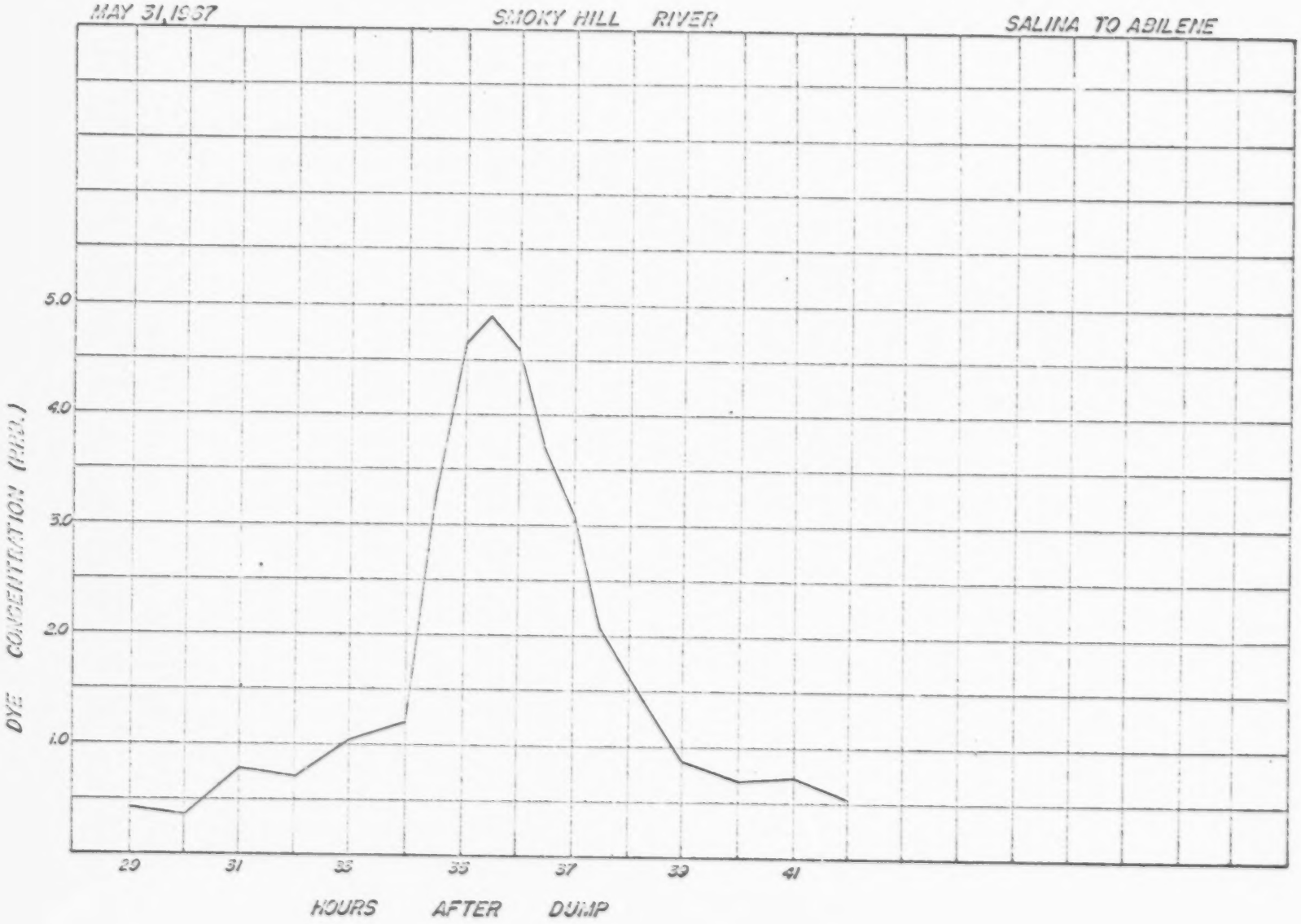

JUNE 7, 1967
SMOKY HILL RIVER
KANOPOLIS TO LINDSBORG
DYE CONCENTRATION (P.P.B.)
5.0
4.0
3.0
2.0
1.0
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
HOURS AFTER DUMP

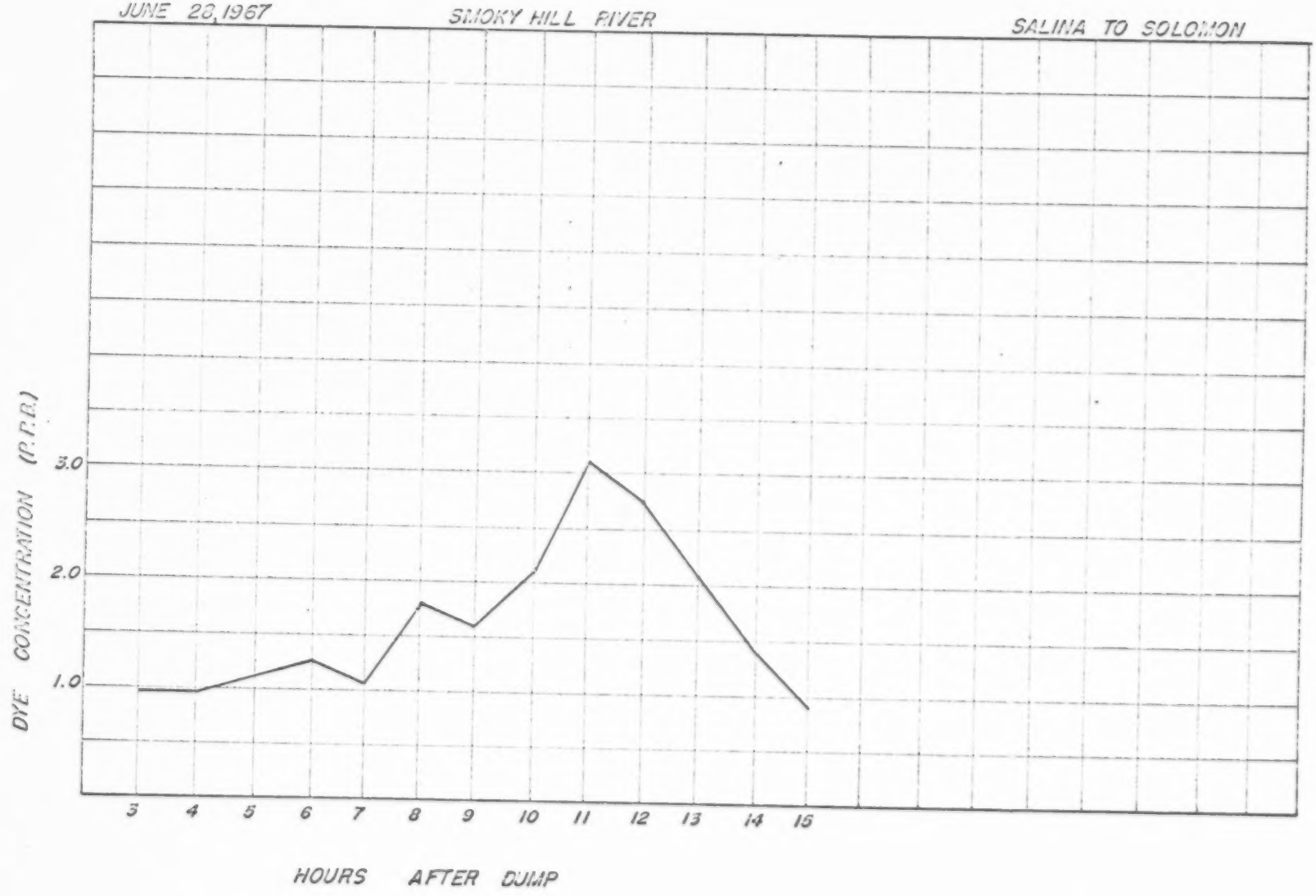

JUNE 18, 1966
SMOKY HILL RIVER
LINDSBORG TO SALINA
DYE CONCENTRATION (PPB)
4.0
3.0
2.0
1.0
8
10
12
14
16
18
20
HOURS AFTER DUMP

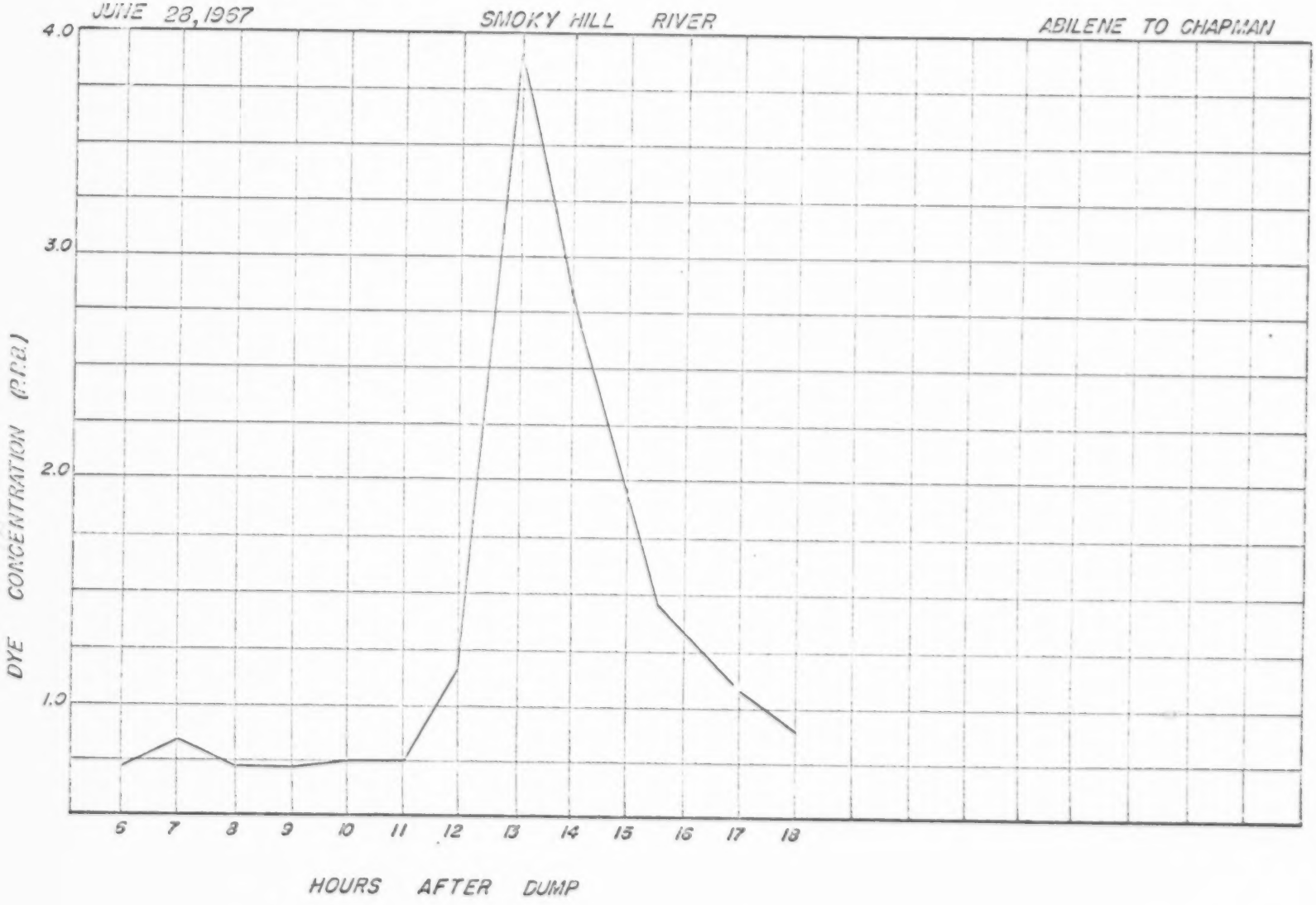

AUG. 26, 1956
SMOKY HILL RIVER
LINDSBORG TO SALINA
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
12
13
14
15
16
17
18
19
20
21
22
HOURS AFTER DUMP

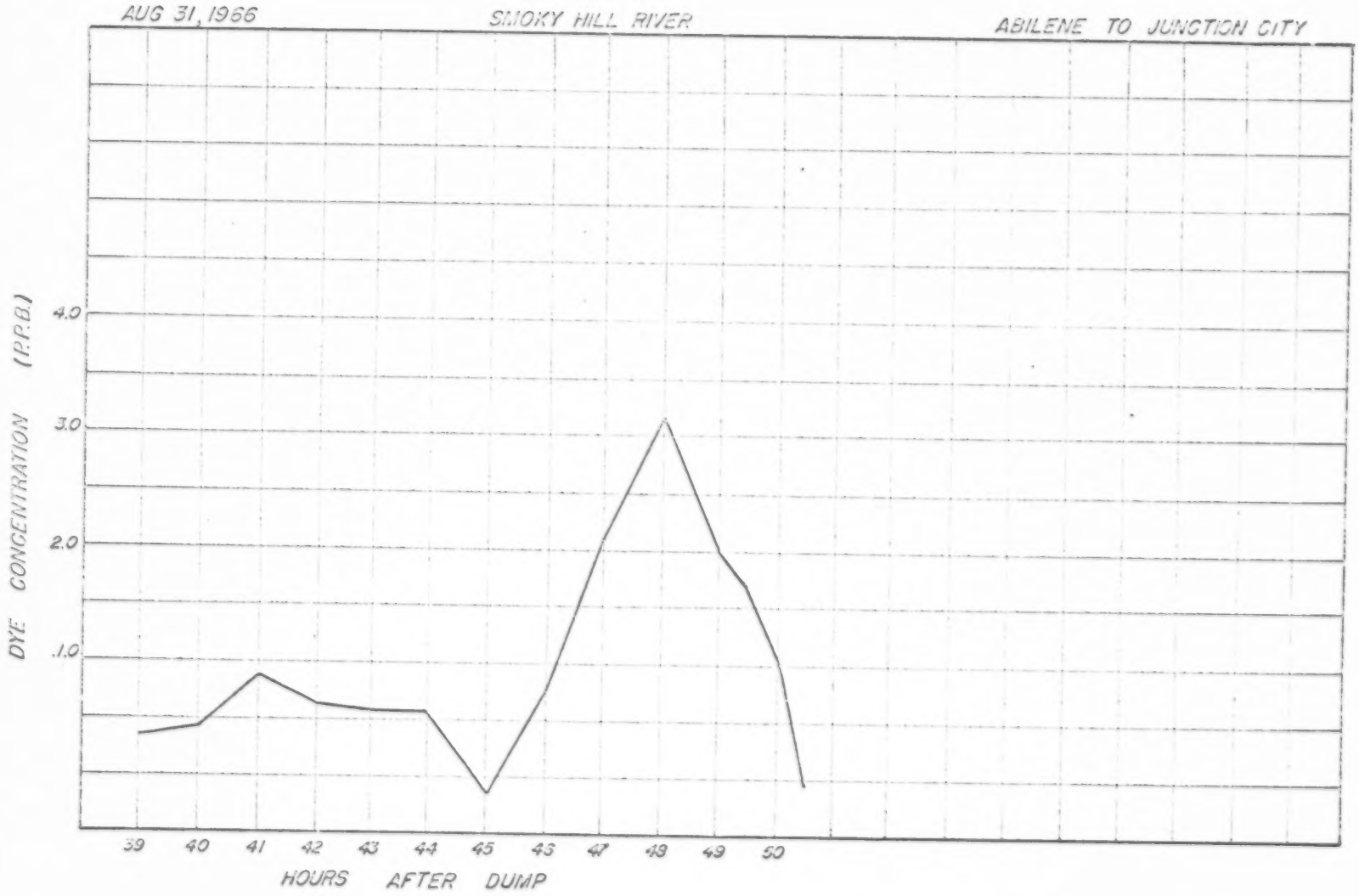

JUNE 7, 1967
SMOKY HILL RIVER
LINDSBORG TO SALINA
DYE CONCENTRATION (P.P.B.)
5.0
4.0
3.0
2.0
1.0
13
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
HOURS AFTER DUMP

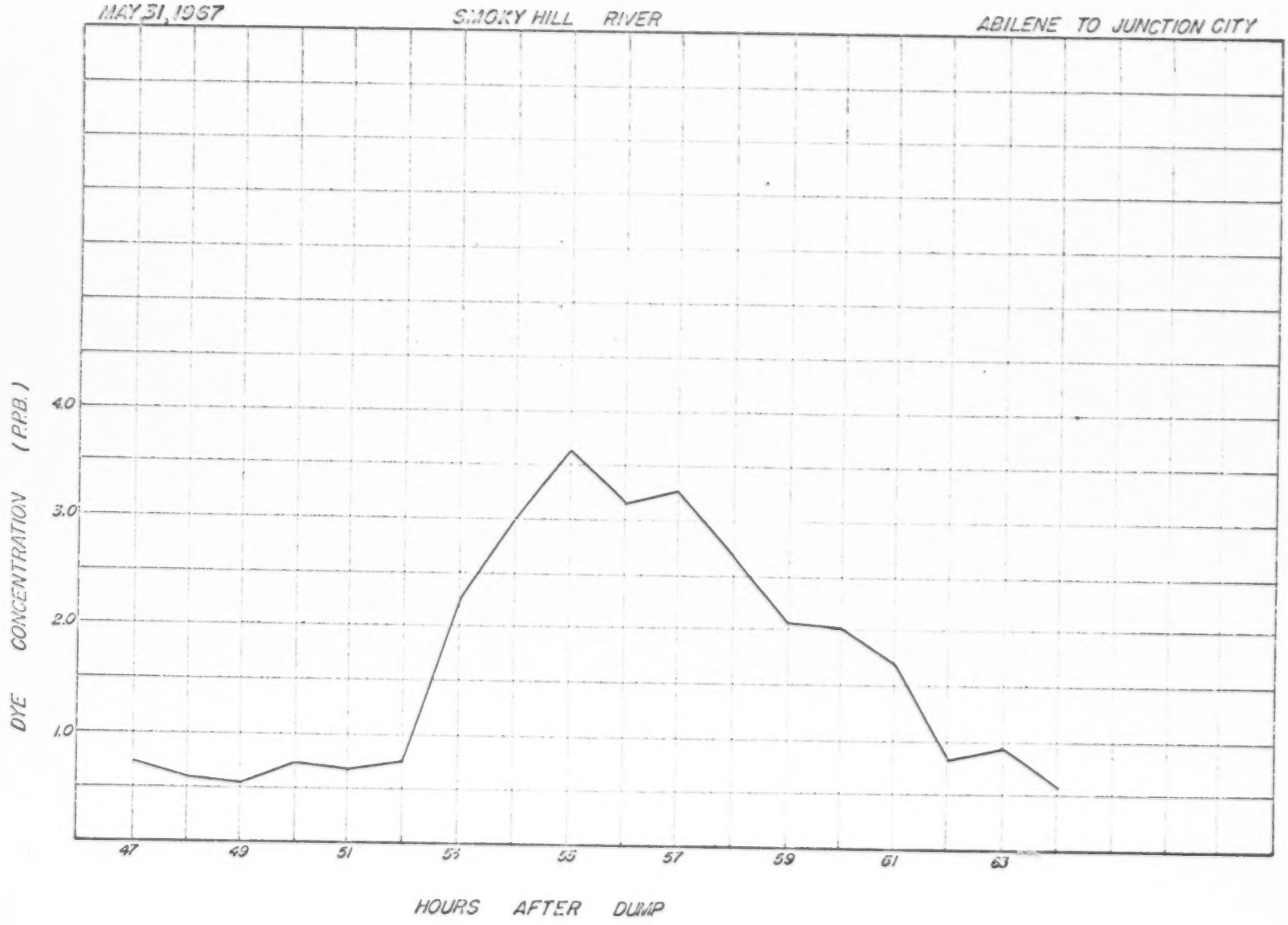

AUG 31, 1966
SMOKY HILL RIVER
SALINA TO ABILENE
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
17
18
19
20
21
23
24
25
26
27
28
HOURS AFTER DUMP

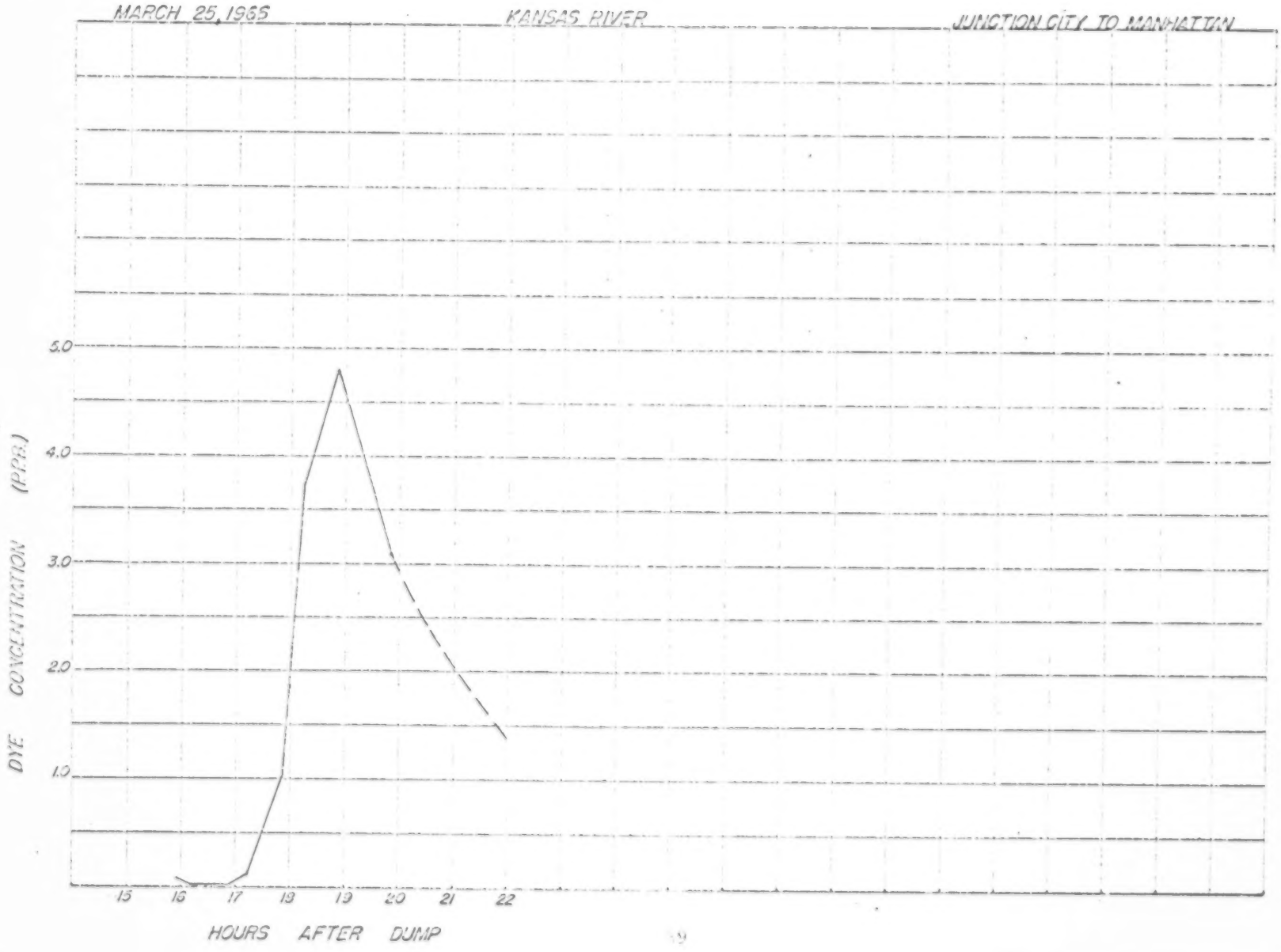

MAY 31, 1957
SMOKY HILL RIVER
SALINA TO ABILENE
DYE CONCENTRATION (PPM.)
5.0
4.0
3.0
2.0
1.0
29
31
33
35
37
39
41
HOURS AFTER DUMP

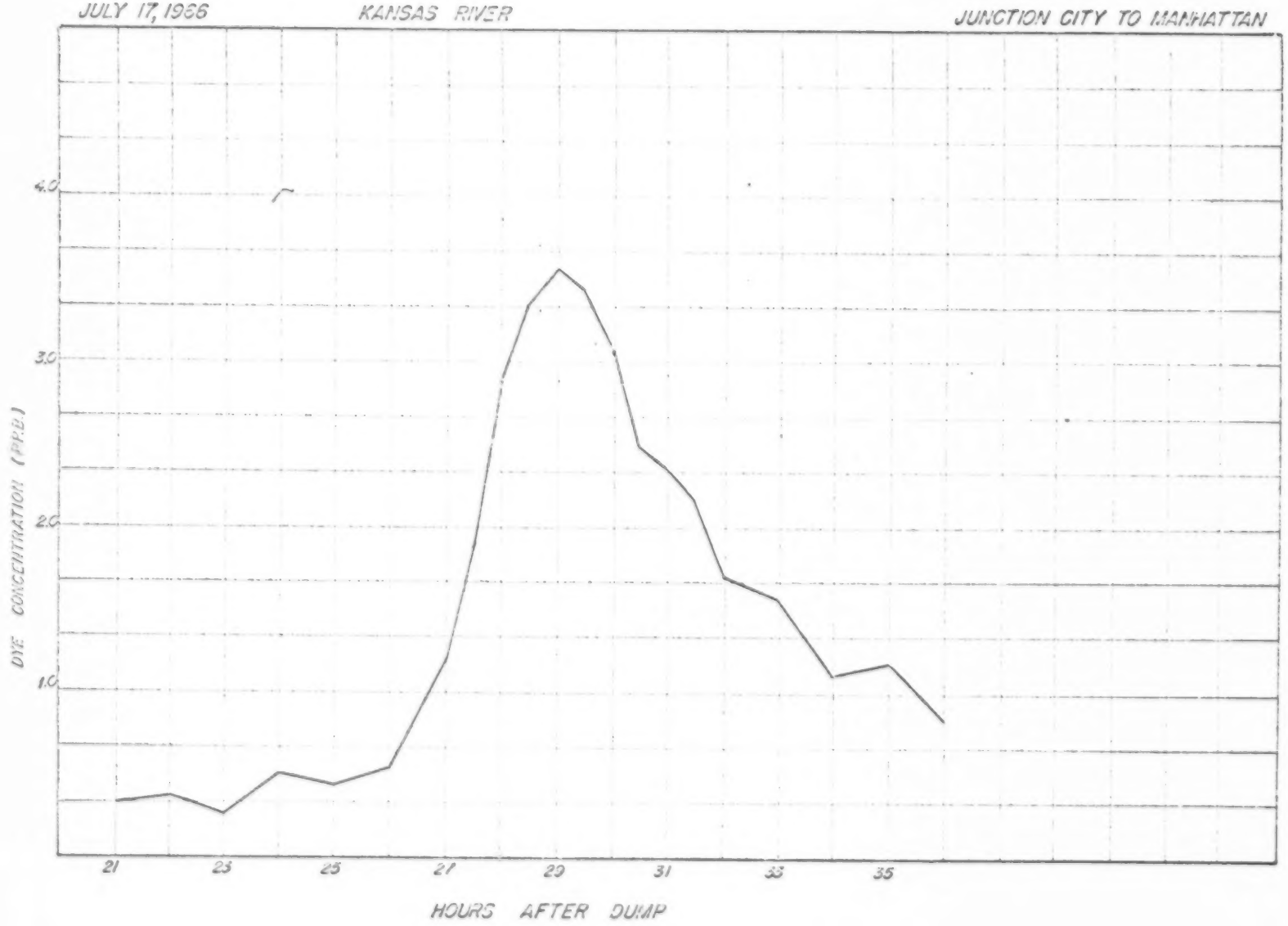

JUNE 28, 1967
SMOKY HILL RIVER
SALINA TO SOLOMON
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
3
4
5
6
7
8
9
10
11
12
13
14
15
HOURS AFTER DUMP

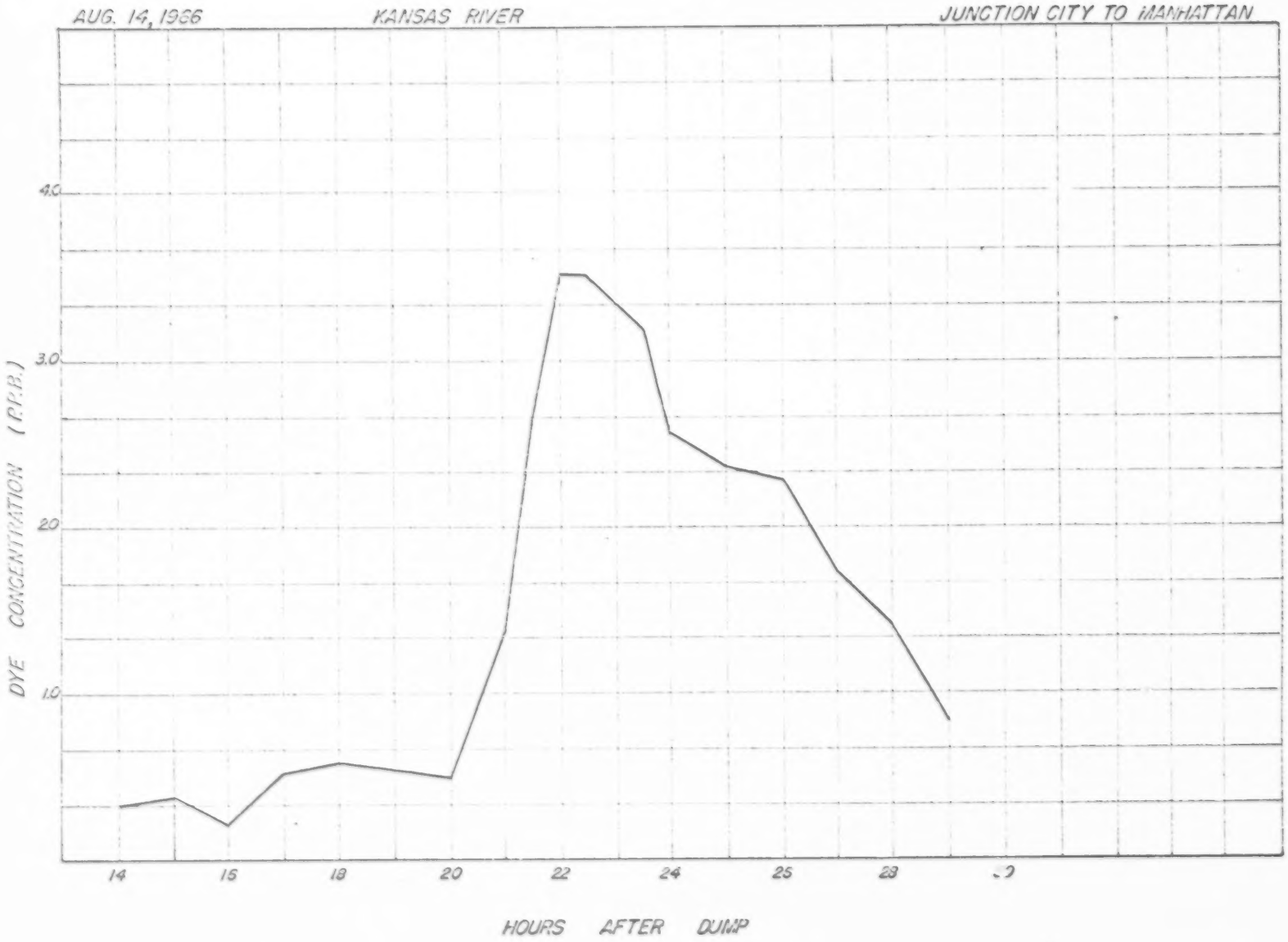

JUNE 28, 1957
SMOKY HILL RIVER
ABILENE TO CHAPMAN
4.0
3.0
2.0
1.0
DYE CONCENTRATION (P.P.B.)
6
7
8
9
10
11
12
13
14
15
16
17
18
HOURS AFTER DUMP

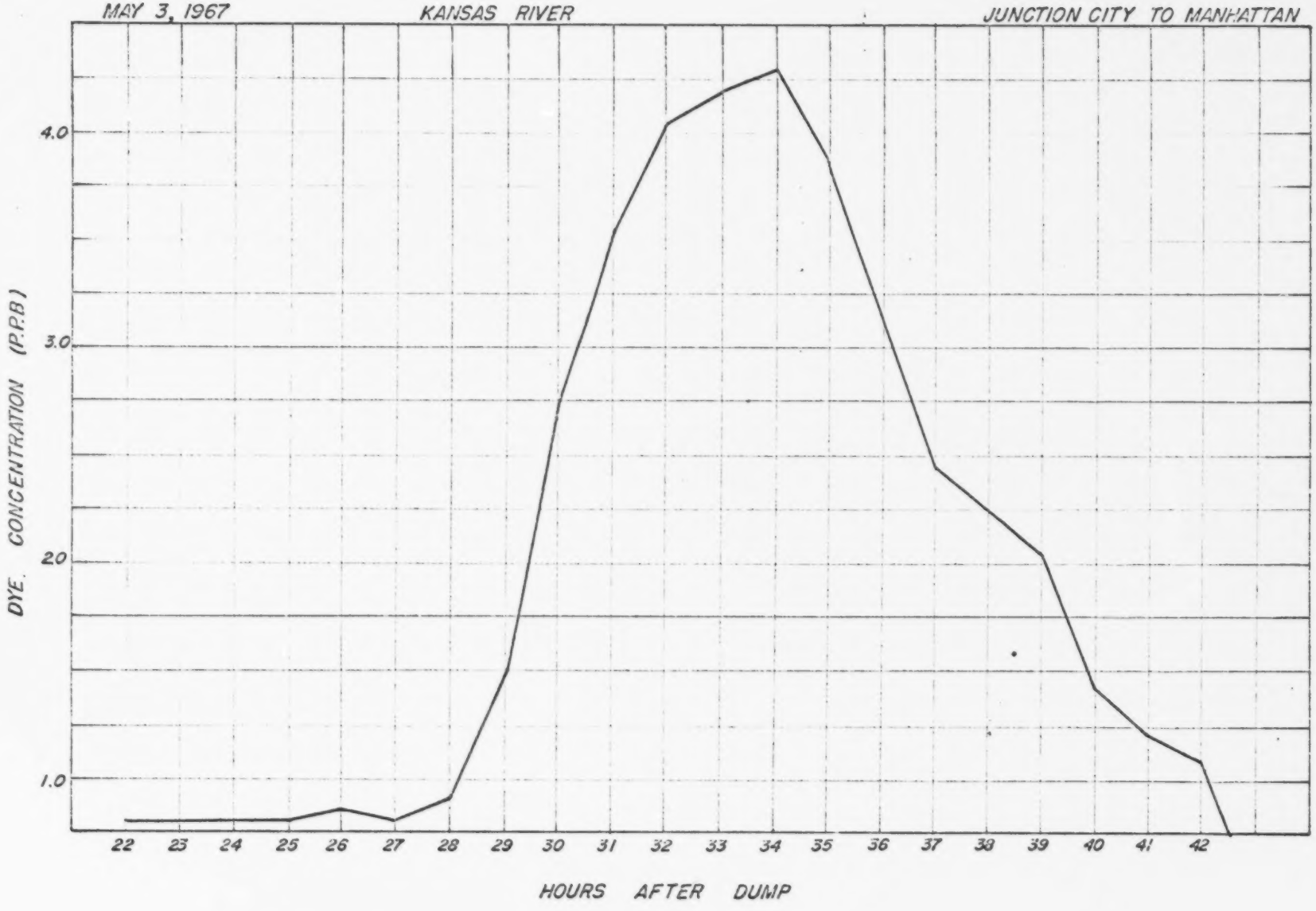

AUG 31, 1966
SMOKY HILL RIVER
ABILENE TO JUNCTION CITY
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
39
40
41
42
43
44
45
46
47
48
49
50
HOURS AFTER DUMP

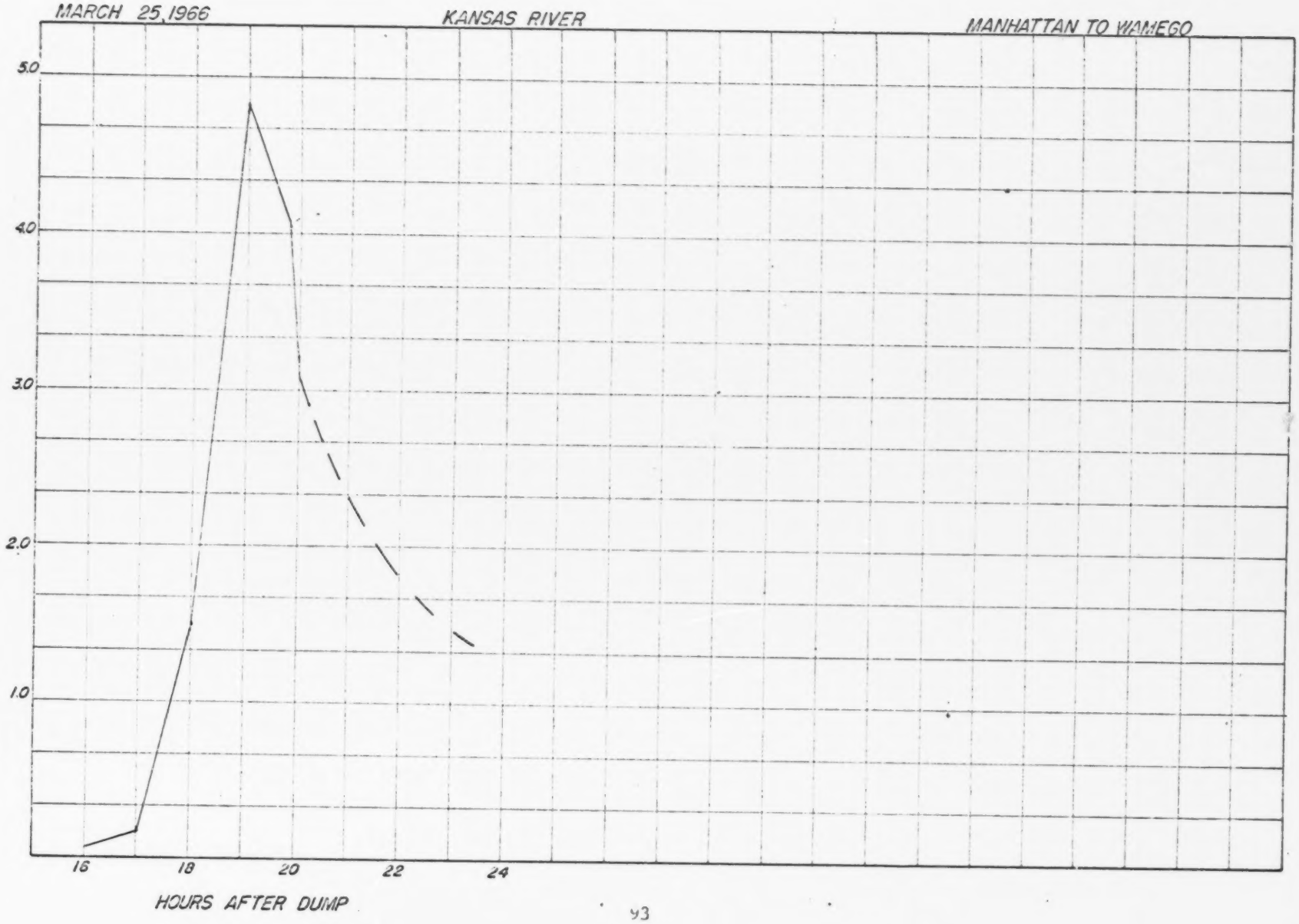

MAY 31, 1967
SMOKY HILL RIVER
ABILENE TO JUNCTION CITY
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
47
49
51
53
55
57
59
61
63
HOURS AFTER DUMP

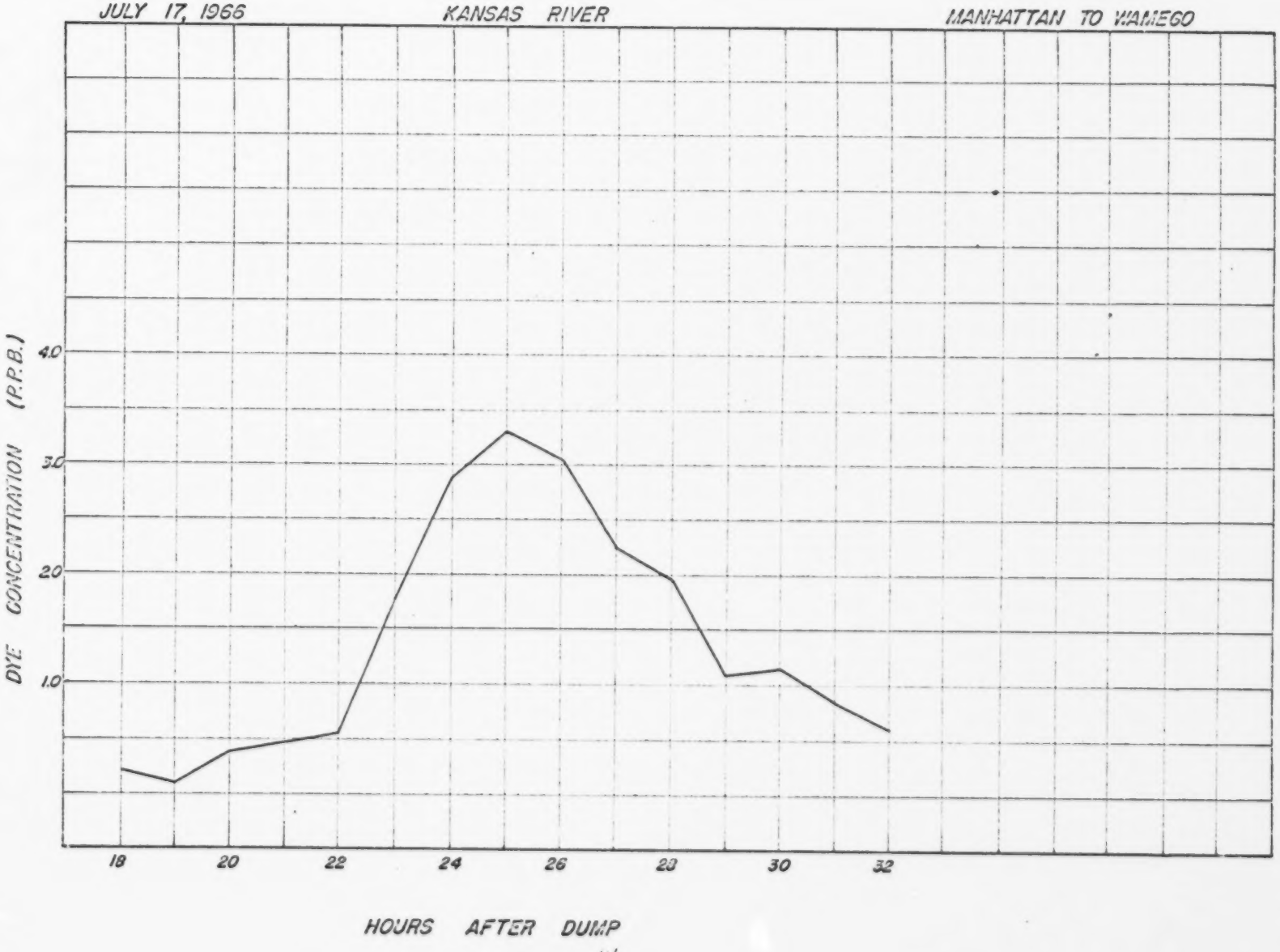

MARCH 25, 1965
KANSAS RIVER
JUNCTION CITY TO MANHATTAN
DYE CONCENTRATION (PPB.)
5.0
4.0
3.0
2.0
1.0
15
16
17
18
19
20
21
22
HOURS AFTER DUMP

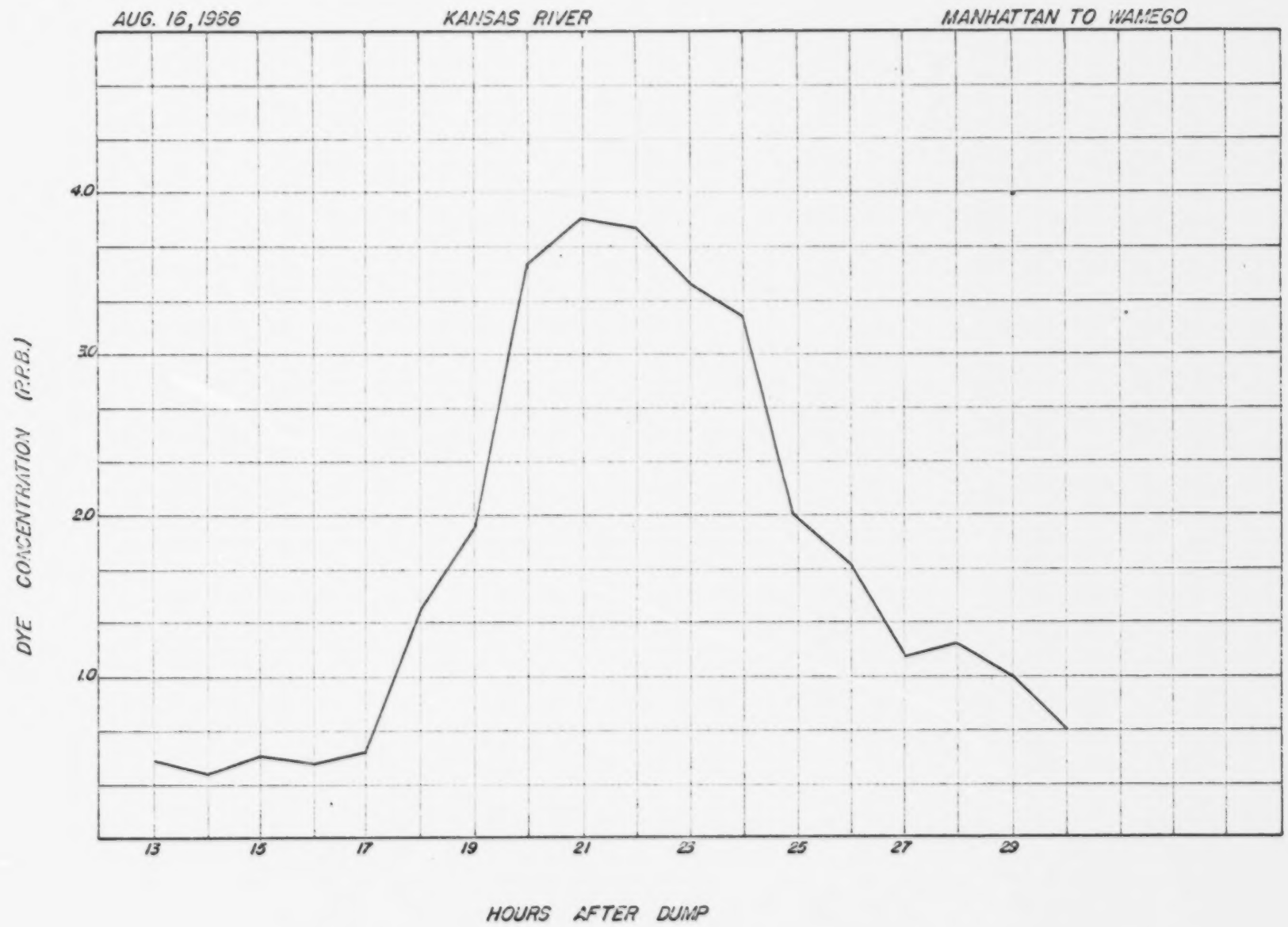

JULY 17, 1966
KANSAS RIVER
JUNCTION CITY TO MANHATTAN
4.0
3.0
2.0
1.0
DYE CONCENTRATION (P.P.B.)
21
23
25
27
29
31
33
35
HOURS AFTER DUMP

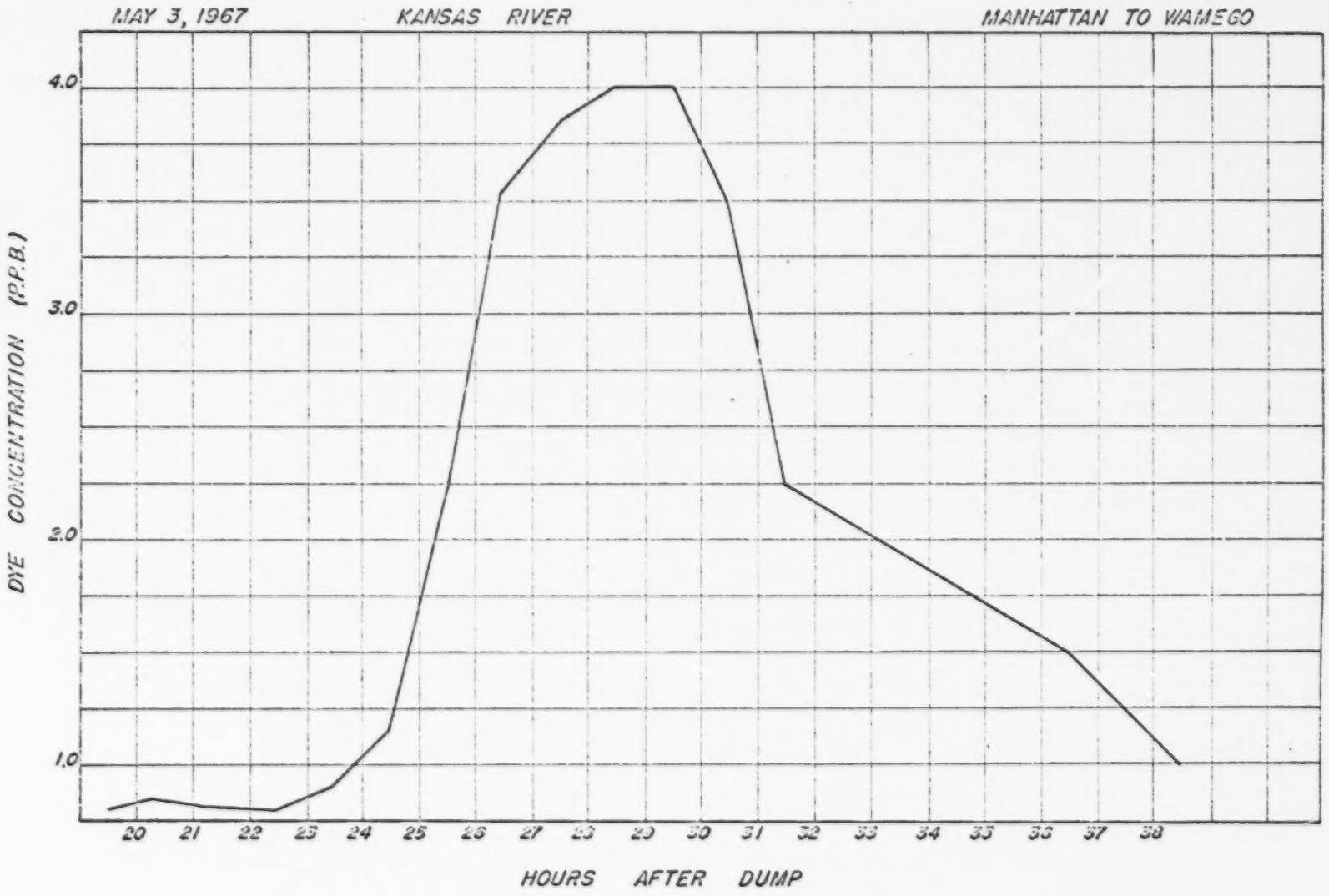

AUG. 14, 1966
KANSAS RIVER
JUNCTION CITY TO MANHATTAN
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
14
16
18
20
22
24
26
28
HOURS AFTER DUMP

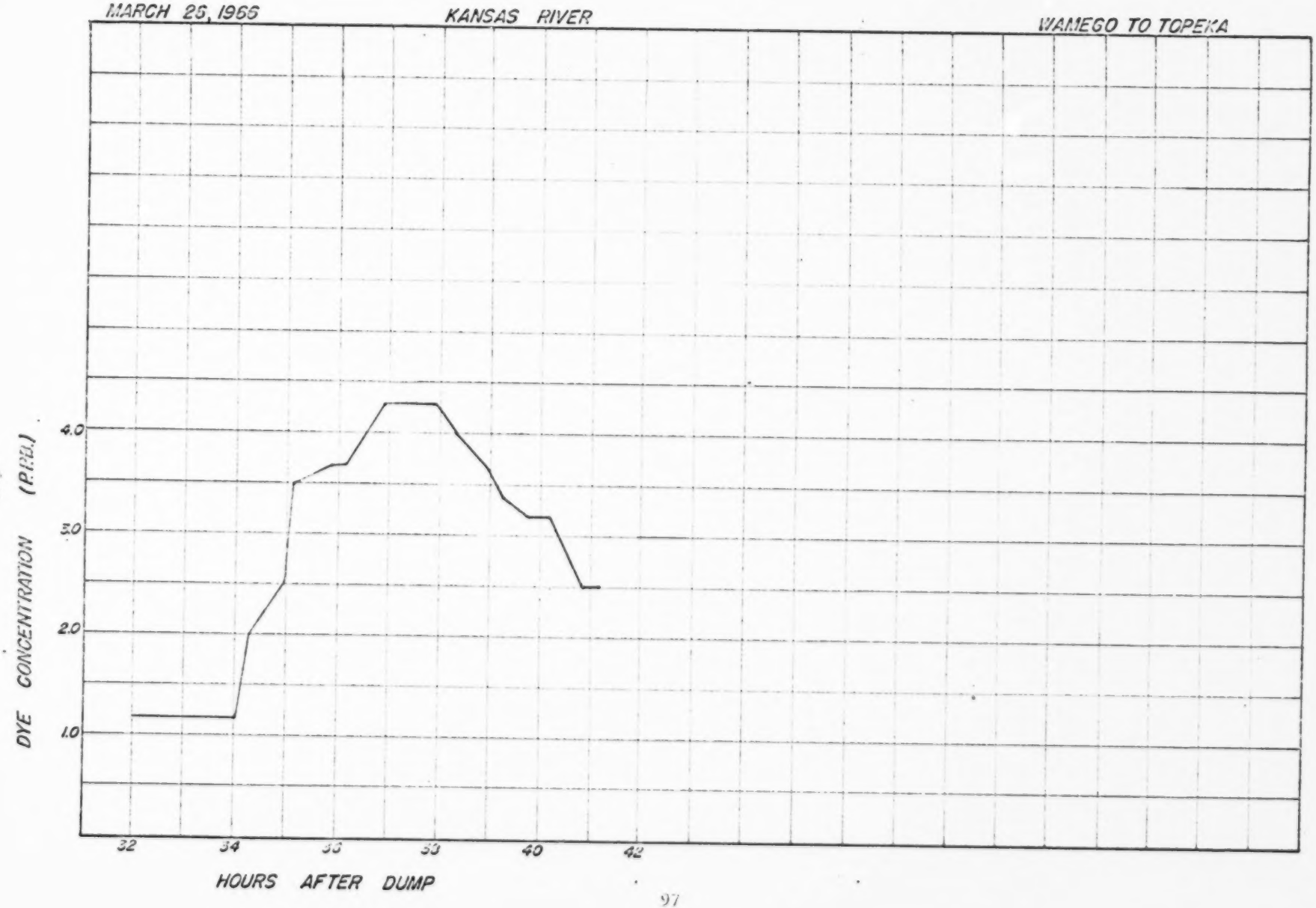

MAY 3, 1967
KANSAS RIVER
JUNCTION CITY TO MANHATTAN
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
HOURS AFTER DUMP

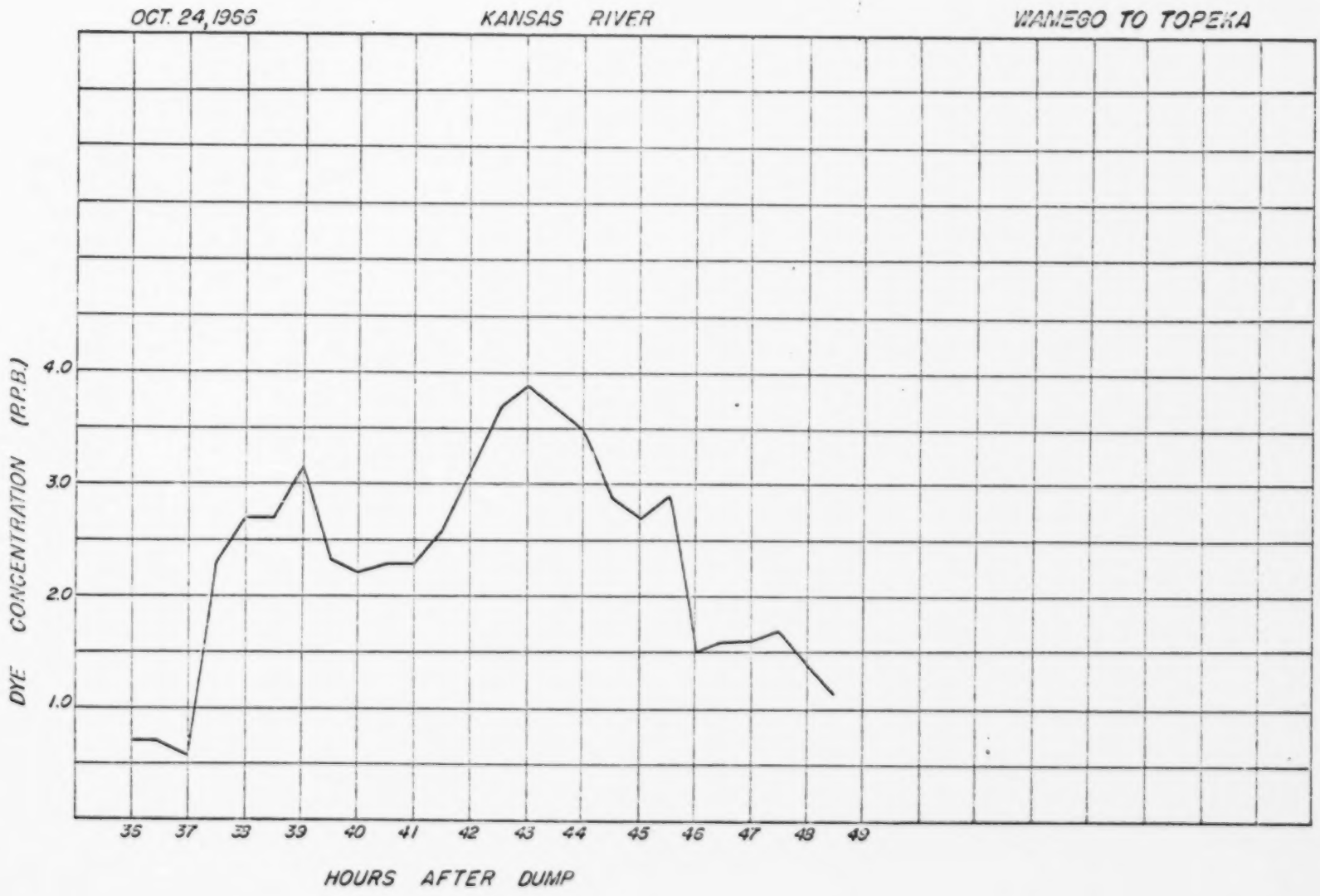

MARCH 25, 1966
KANSAS RIVER
MANHATTAN TO WAMEGO
5.0
4.0
3.0
2.0
1.0
DYE CONCENTRATION (P.P.B.)
16
18
20
22
24
HOURS AFTER DUMP

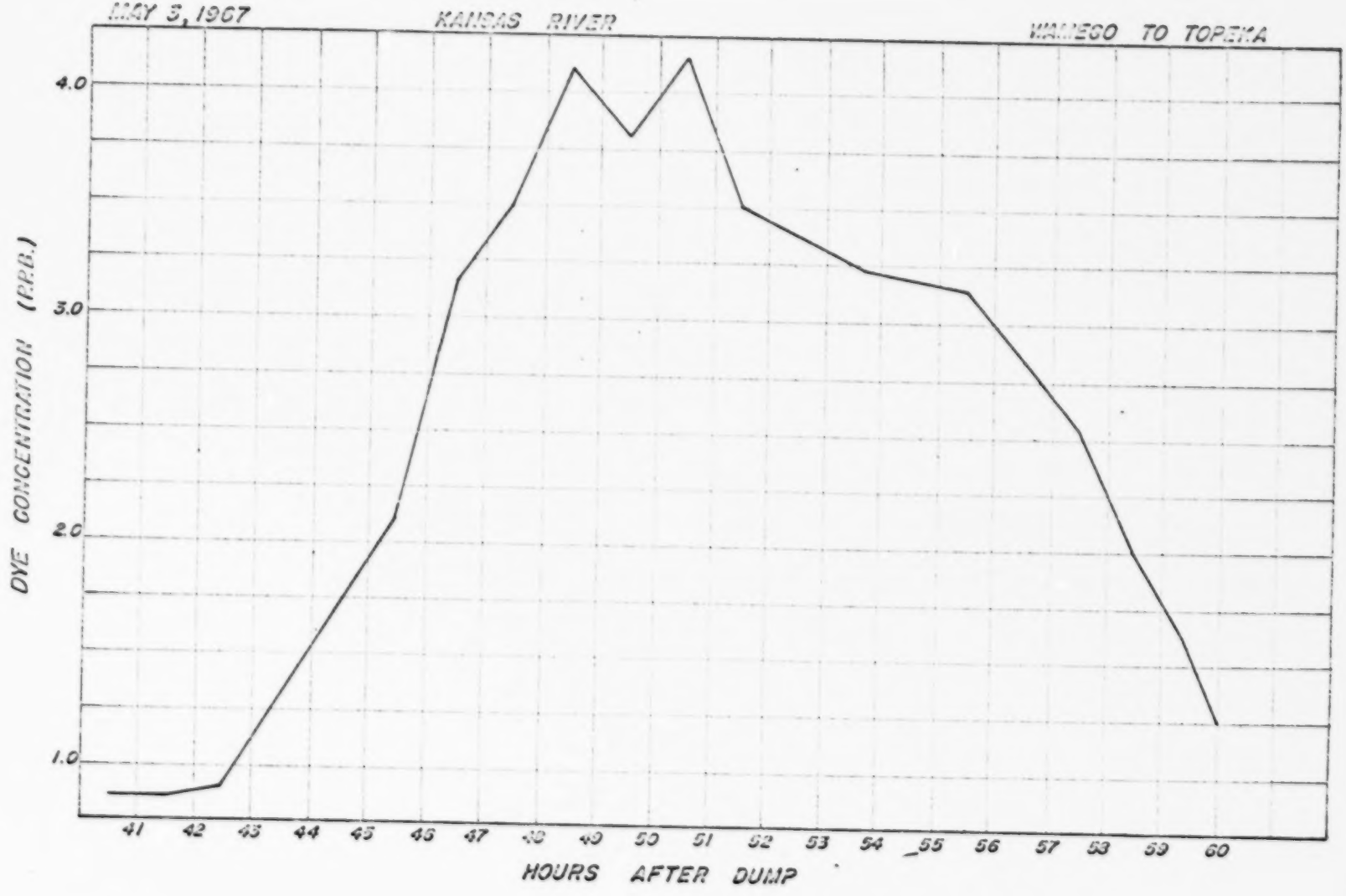

JULY 17, 1966
KANSAS RIVER
MANHATTAN TO WAMEGO
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
18
20
22
24
26
28
30
32
HOURS AFTER DUMP

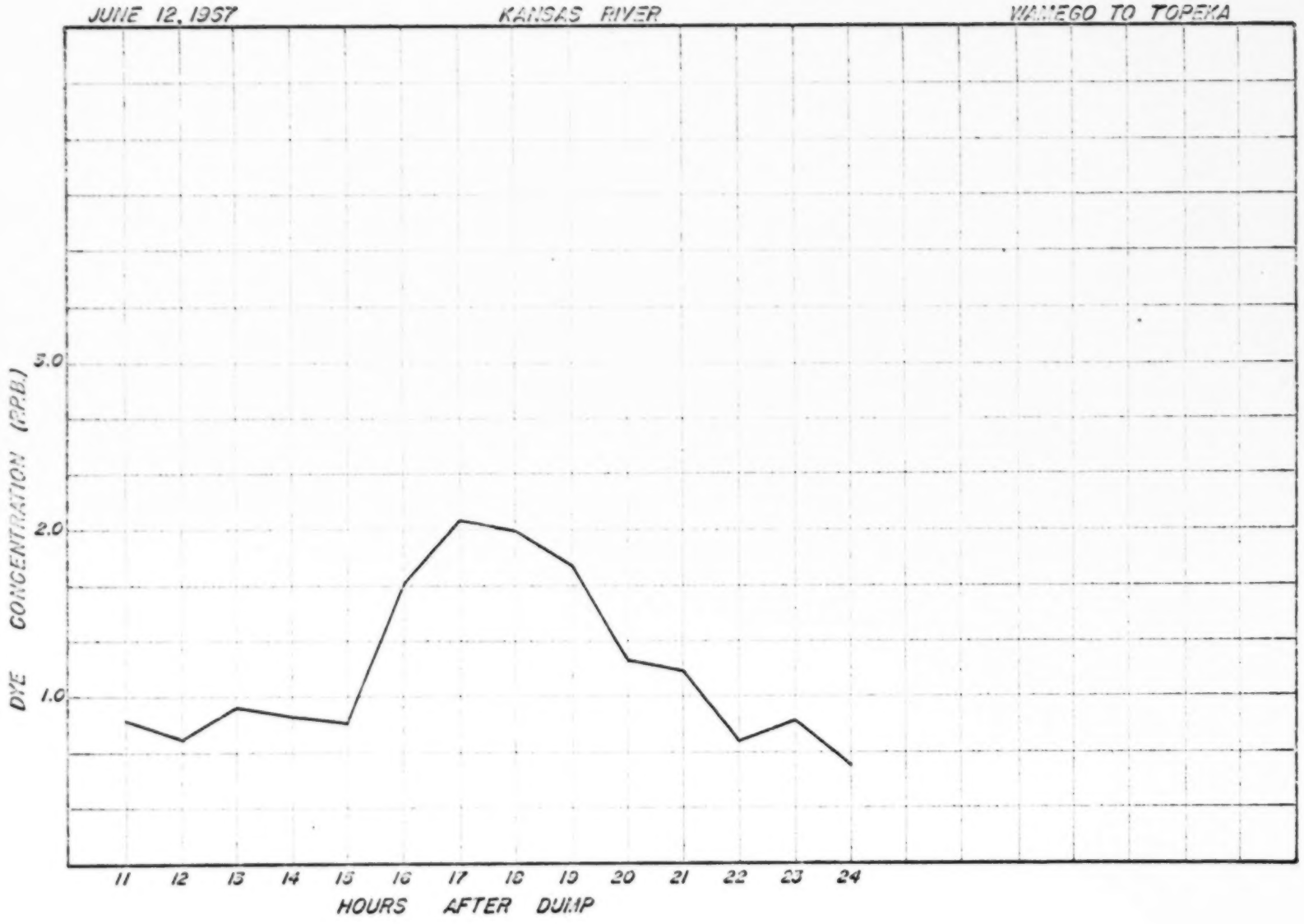

AUG. 16, 1956
KANSAS RIVER
MANHATTAN TO WAMEGO
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
13
15
17
19
21
23
25
27
29
HOURS AFTER DUMP

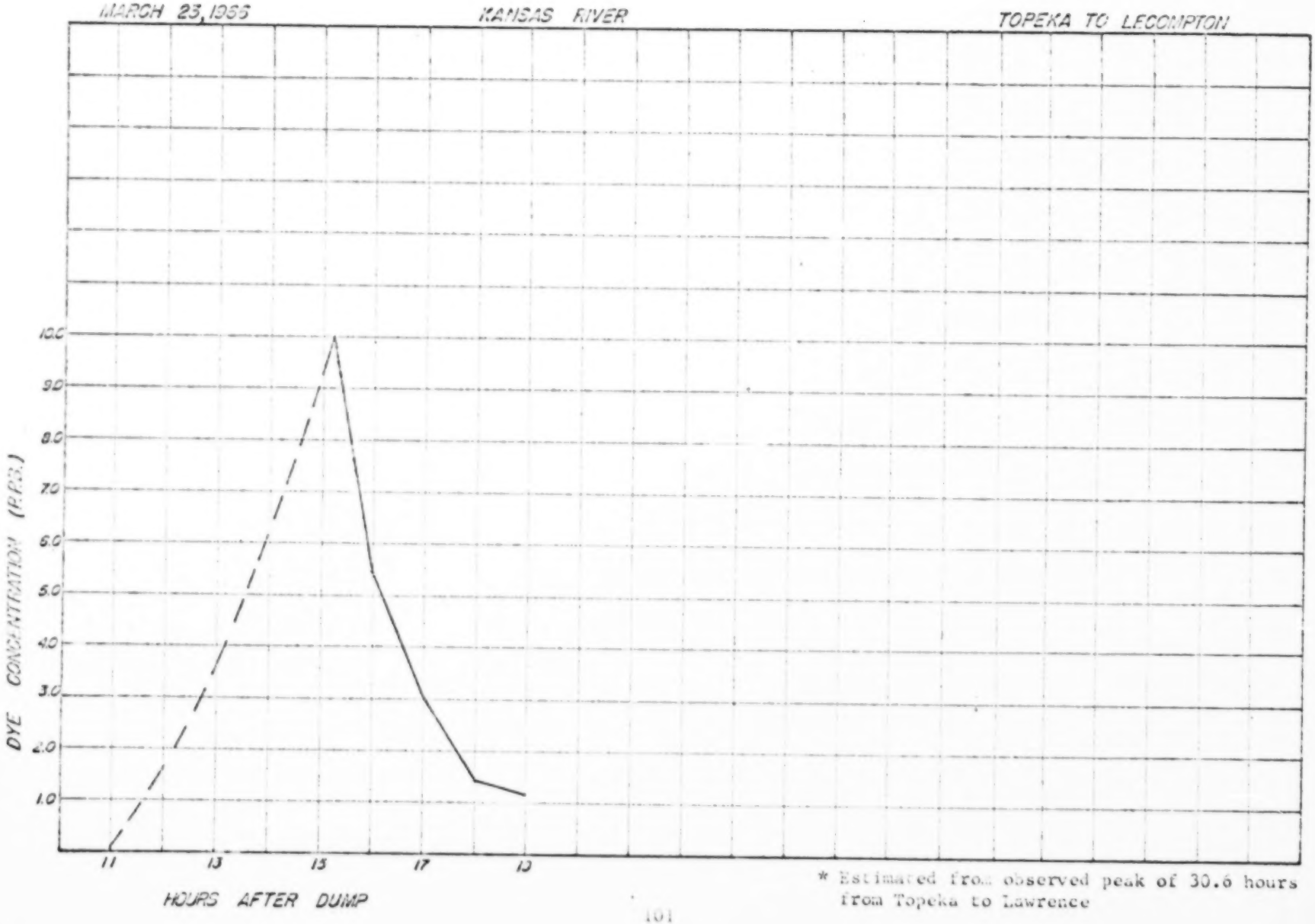

MAY 3, 1967
KANSAS RIVER
MANHATTAN TO WAMEGO
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
HOURS AFTER DUMP


MARCH 25, 1966
KANSAS RIVER
WAMEGO TO TOPEKA
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
32
34
36
38
40
42
HOURS AFTER DUMP

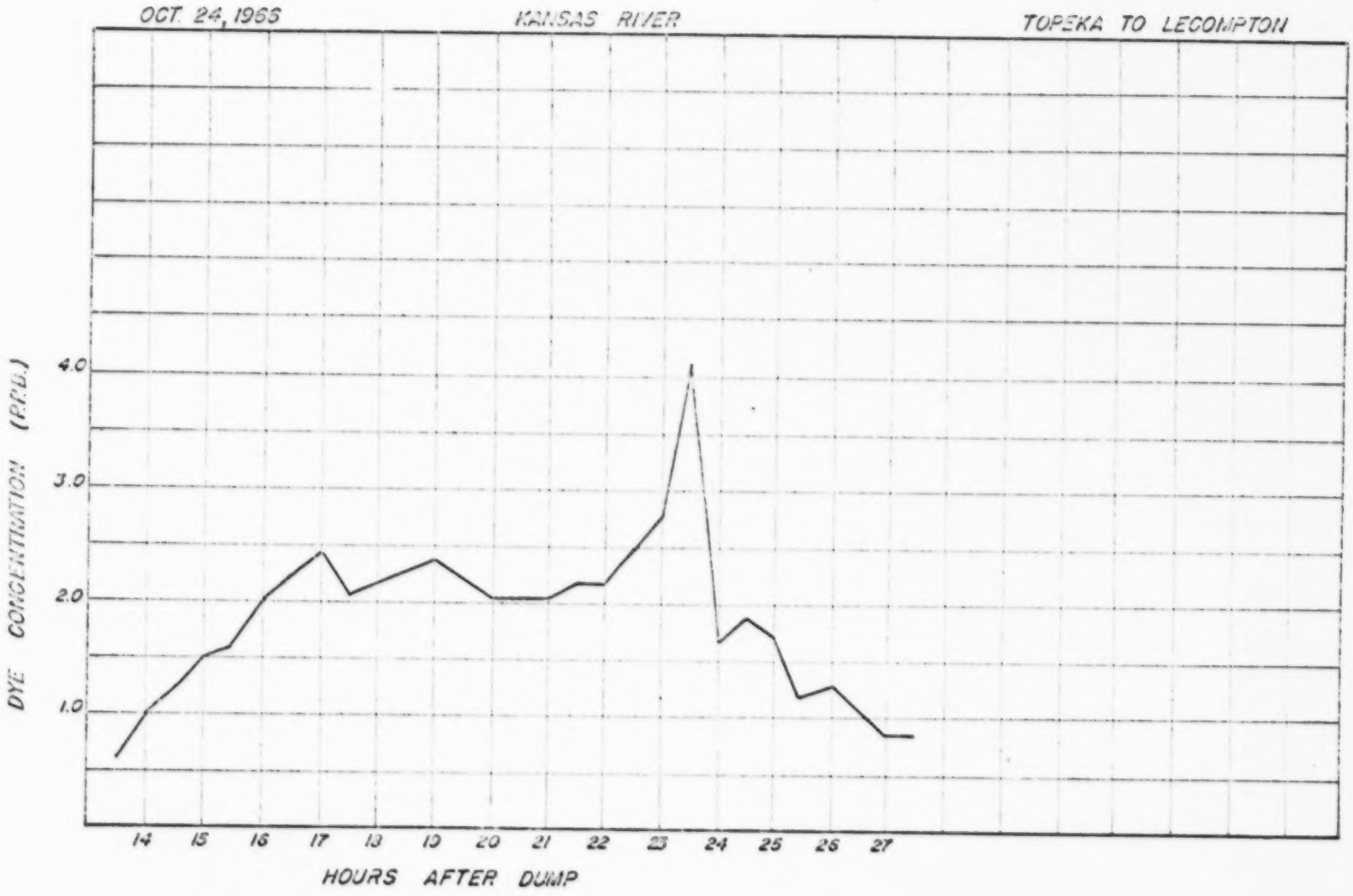

OCT. 24, 1956
KANSAS RIVER
WAMEGO TO TOPEKA
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
35
37
38
39
40
41
42
43
44
45
46
47
48
49
HOURS AFTER DUMP

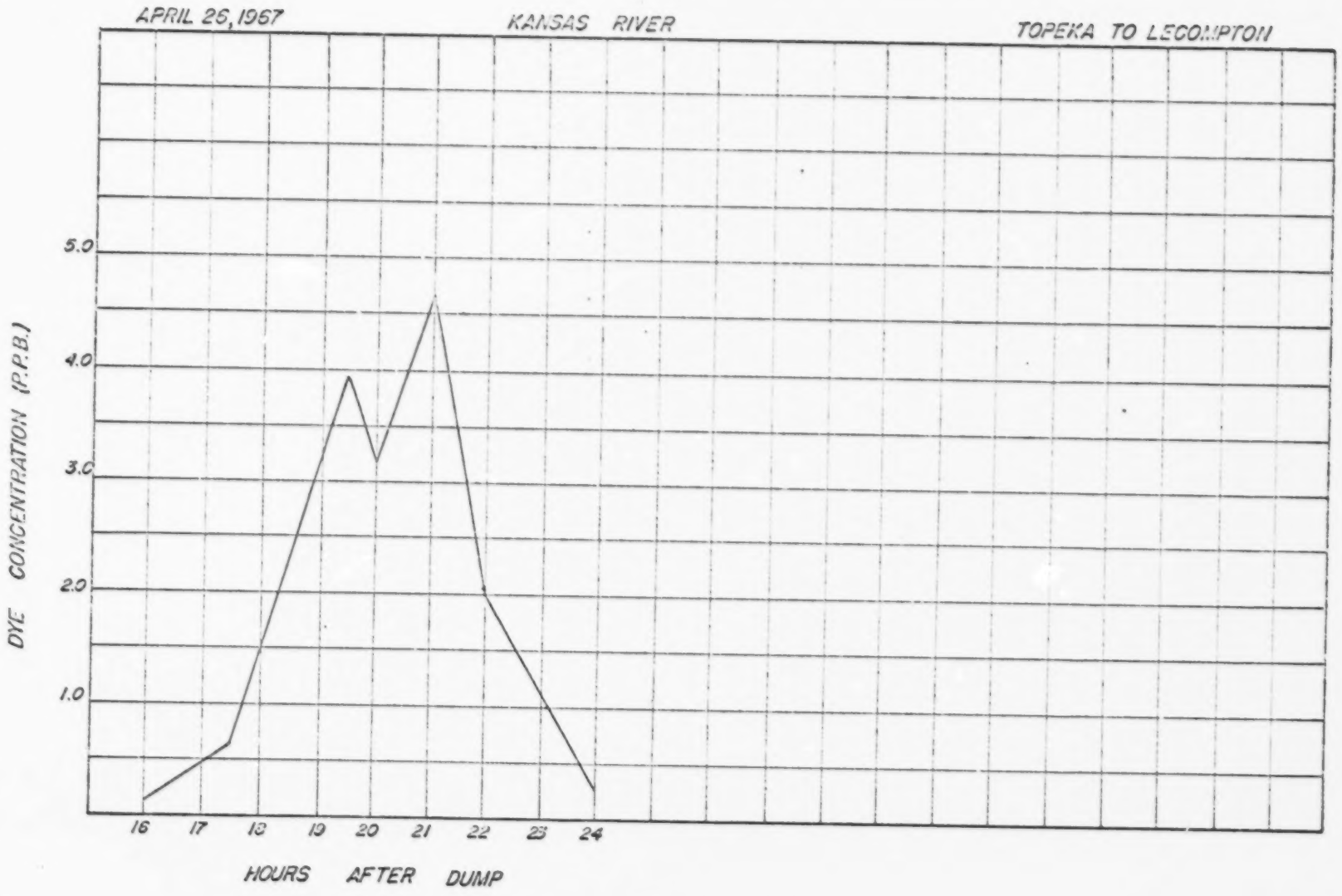

MAY 3, 1967
KANSAS RIVER
WAMEGO TO TOPEKA
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
HOURS AFTER DUMP

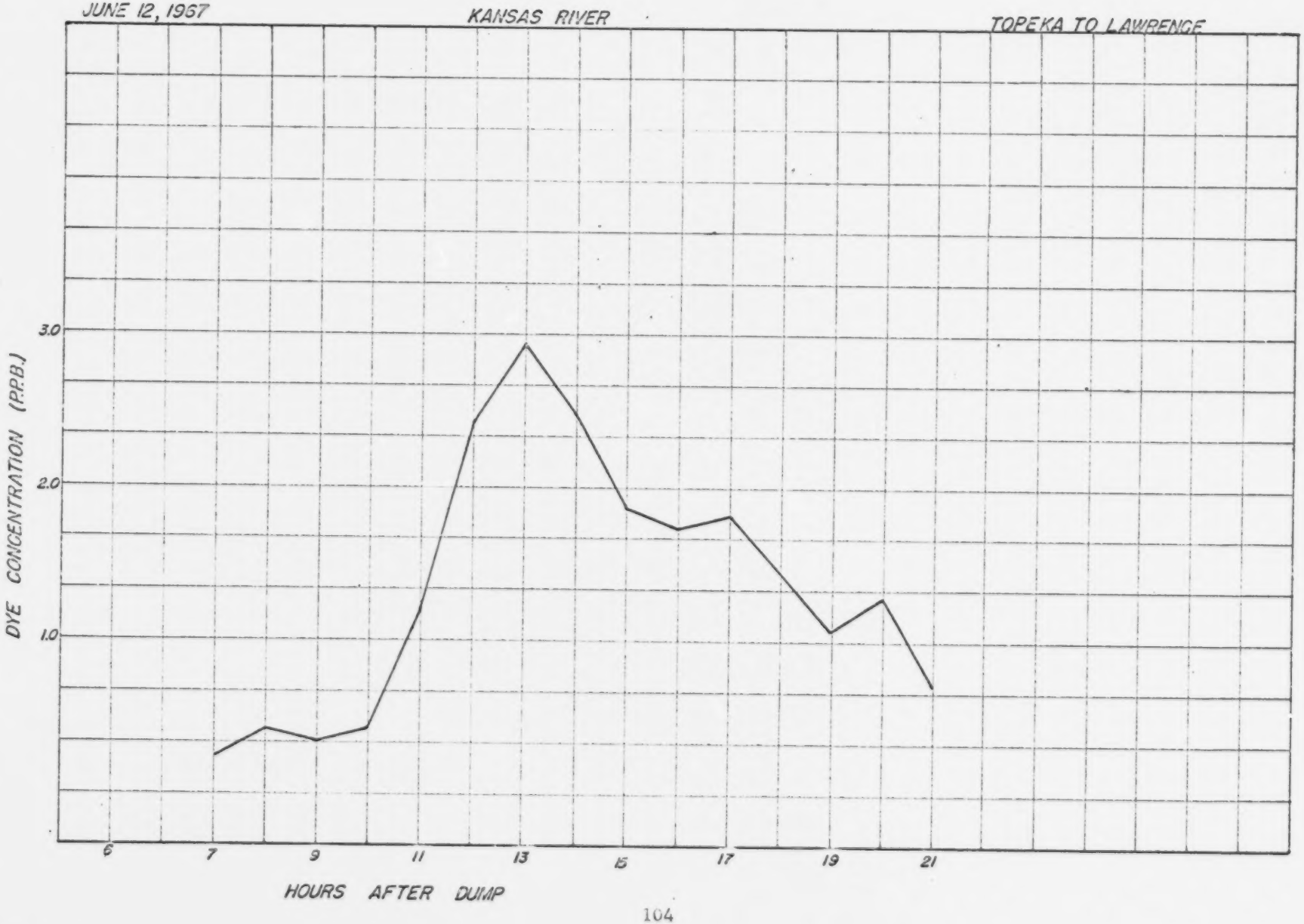

JUNE 12, 1957
KANSAS RIVER
WAMEGO TO TOPEKA
DYE CONCENTRATION (P.P.B.)
5.0
2.0
1.0
11
12
13
14
15
16
17
18
19
20
21
22
23
24
HOURS AFTER DUMP

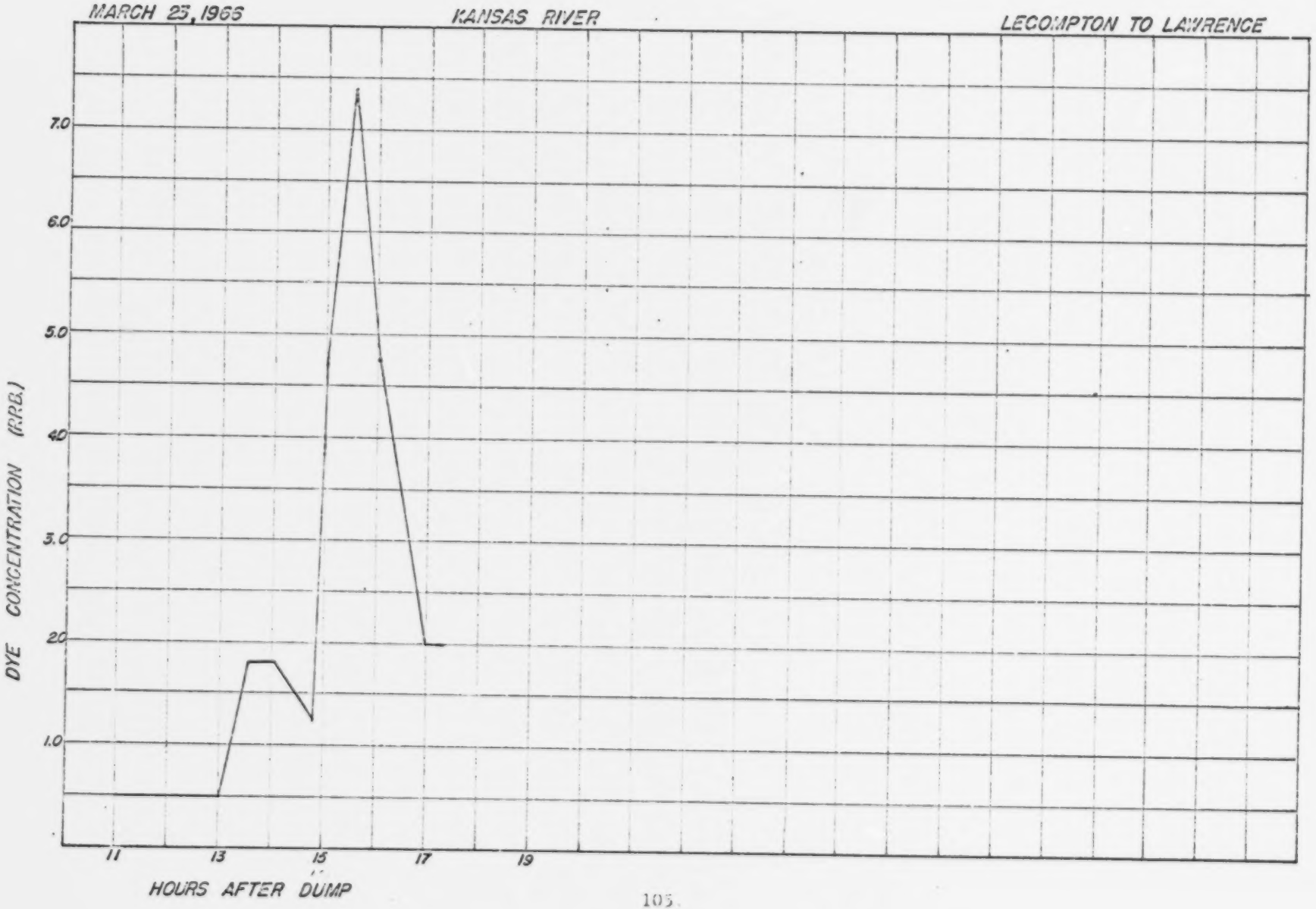


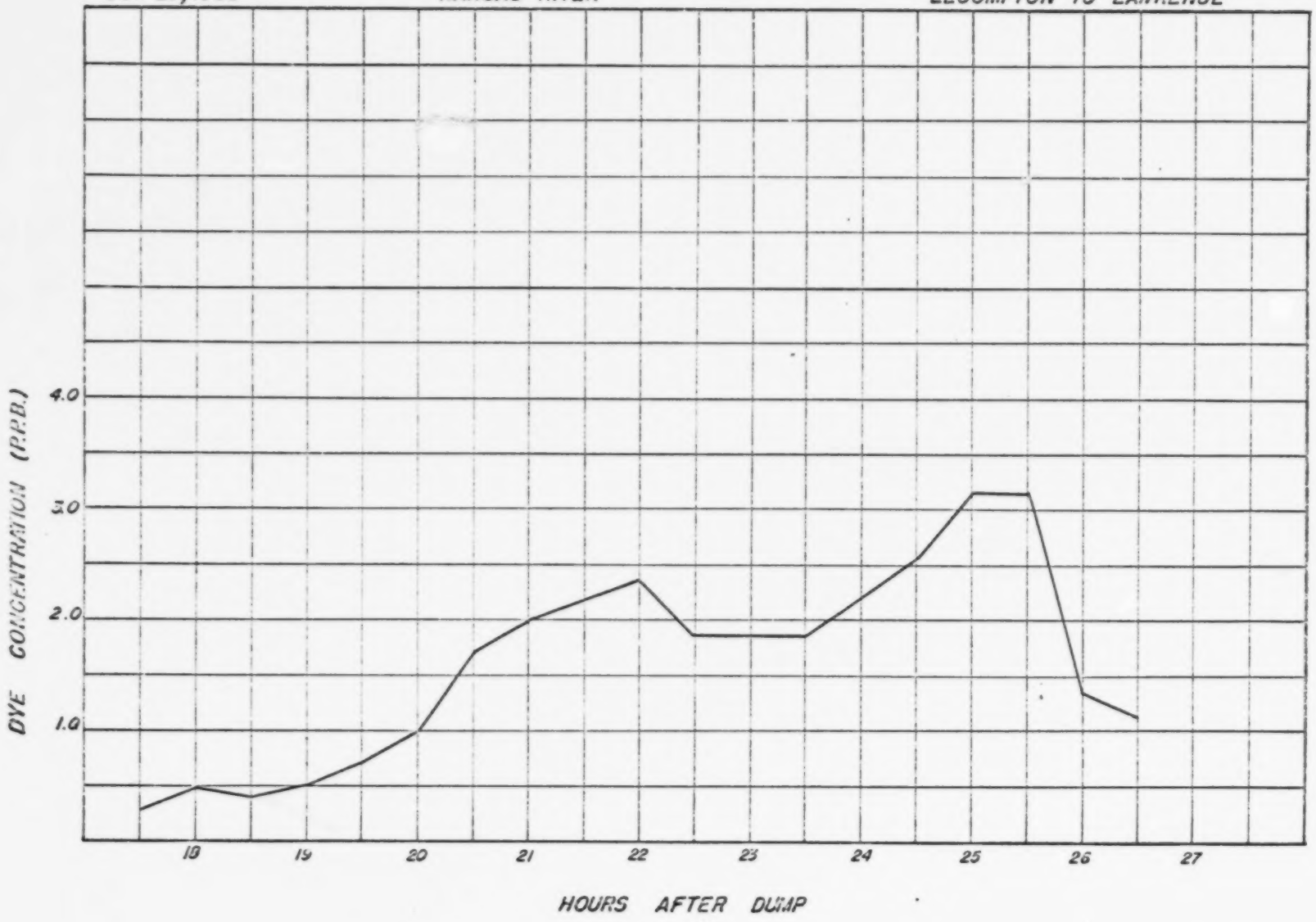
* Estimated from observed peak of 30.6 hours from Topeka to Lawrence

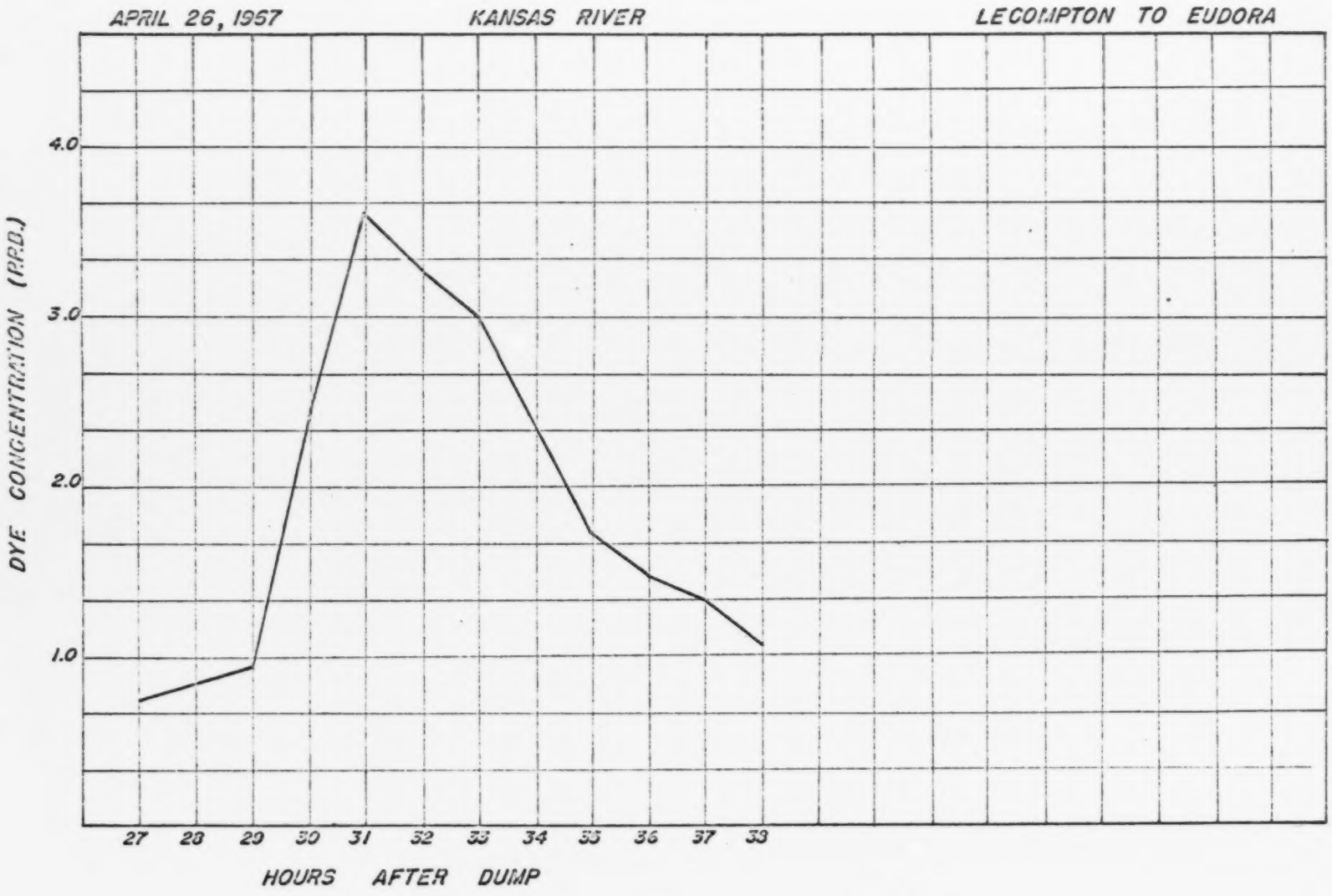

OCT. 24, 1963
KANSAS RIVER
TOPEKA TO LECOMPTON
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
14
15
16
17
18
19
20
21
22
23
24
25
26
27
HOURS AFTER DUMP

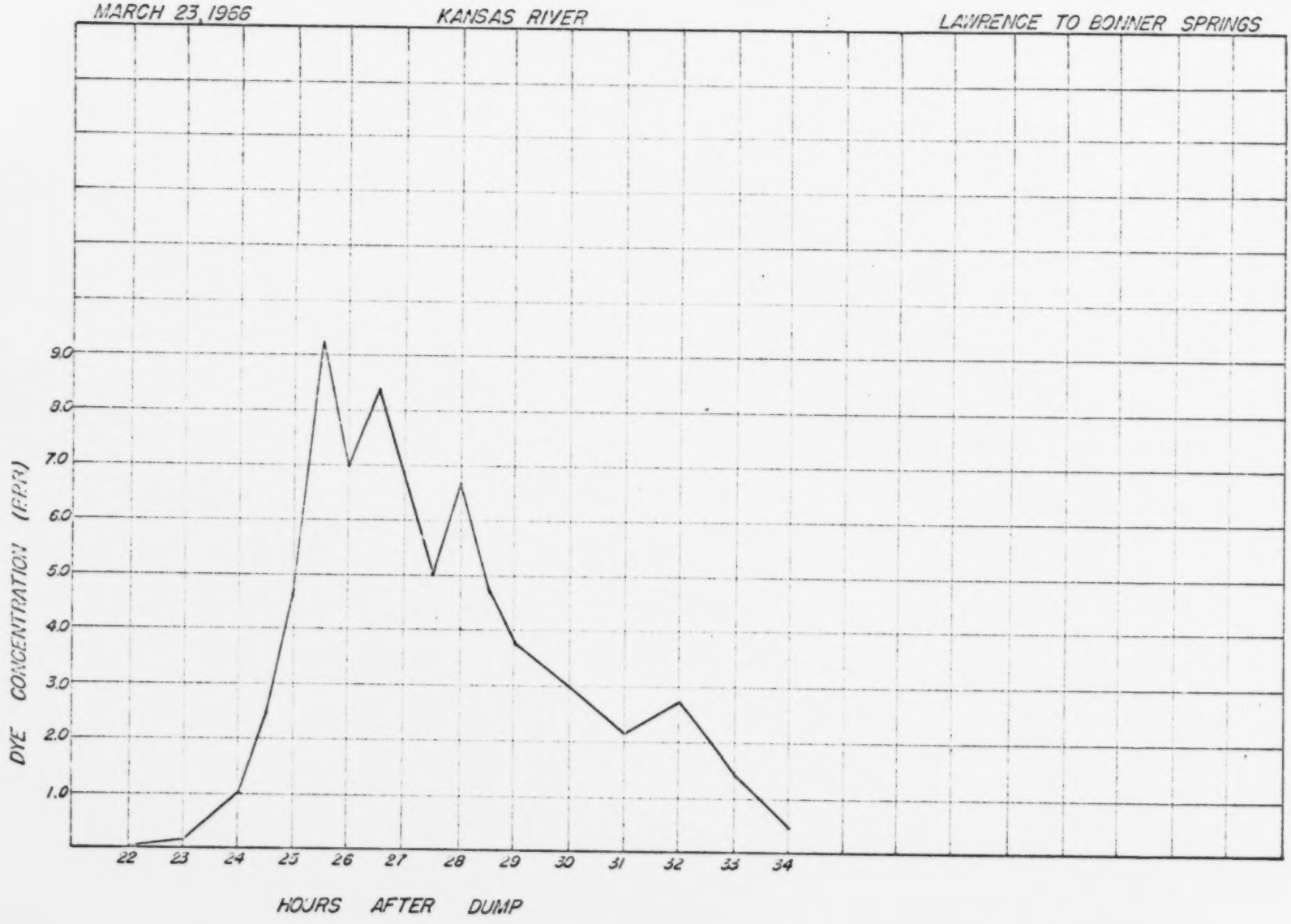

APRIL 26, 1967
KANSAS RIVER
TOPEKA TO LECOMPTON
DYE CONCENTRATION (P.P.B.)
5.0
4.0
3.0
2.0
1.0
16
17
18
19
20
21
22
23
24
HOURS AFTER DUMP

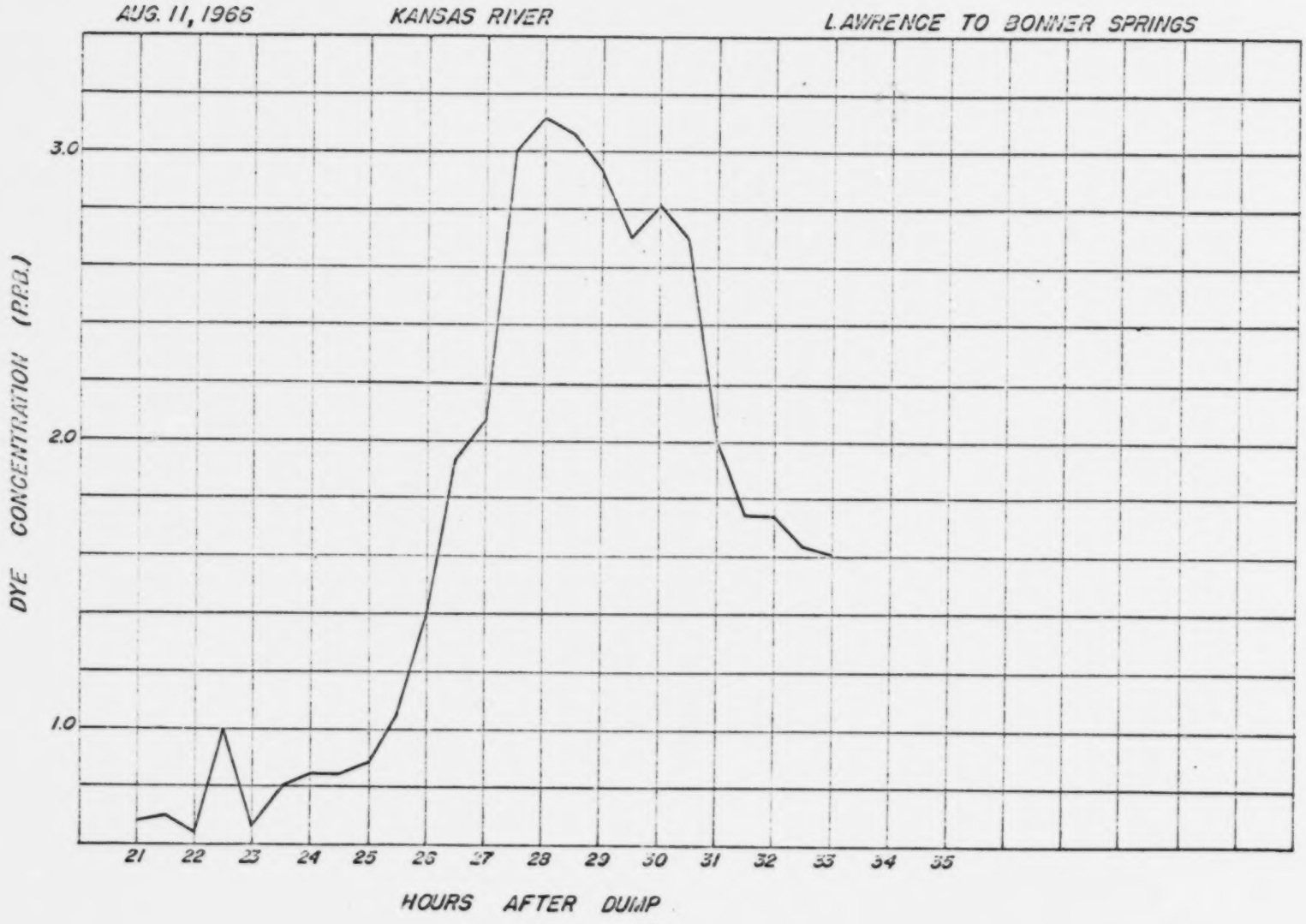

JUNE 12, 1967
KANSAS RIVER
TOPEKA TO LAWRENCE
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
6
7
9
11
13
15
17
19
21
HOURS AFTER DUMP

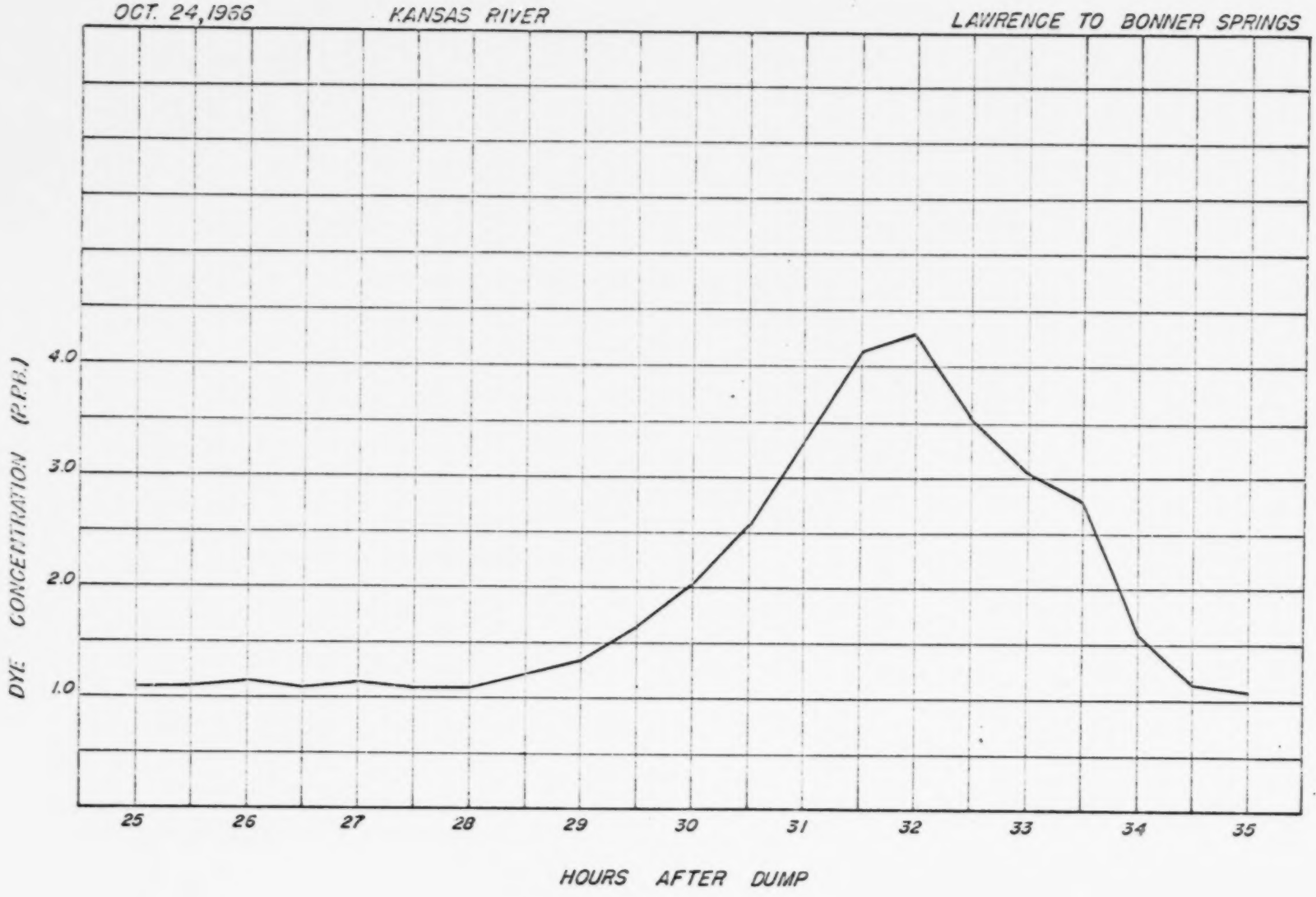

MARCH 25, 1965
KANSAS RIVER
LECOMPTON TO LAWRENCE
DYE CONCENTRATION (R.B.)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
11
13
15
17
19
HOURS AFTER DUMP

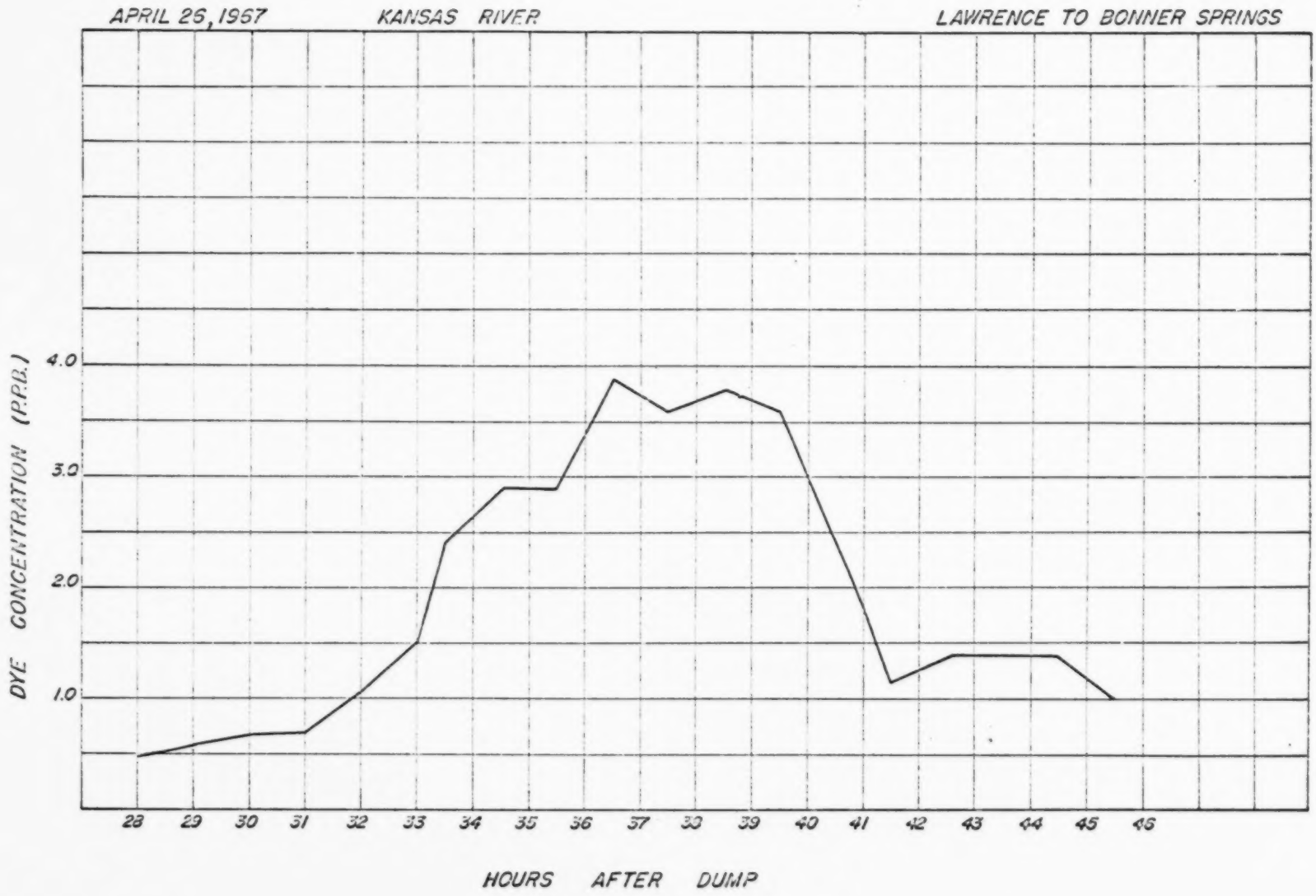

OCT. 23, 1966
KANSAS RIVER
LECOMPTON TO LAWRENCE
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
18
19
20
21
22
23
24
25
26
27
HOURS AFTER DUMP

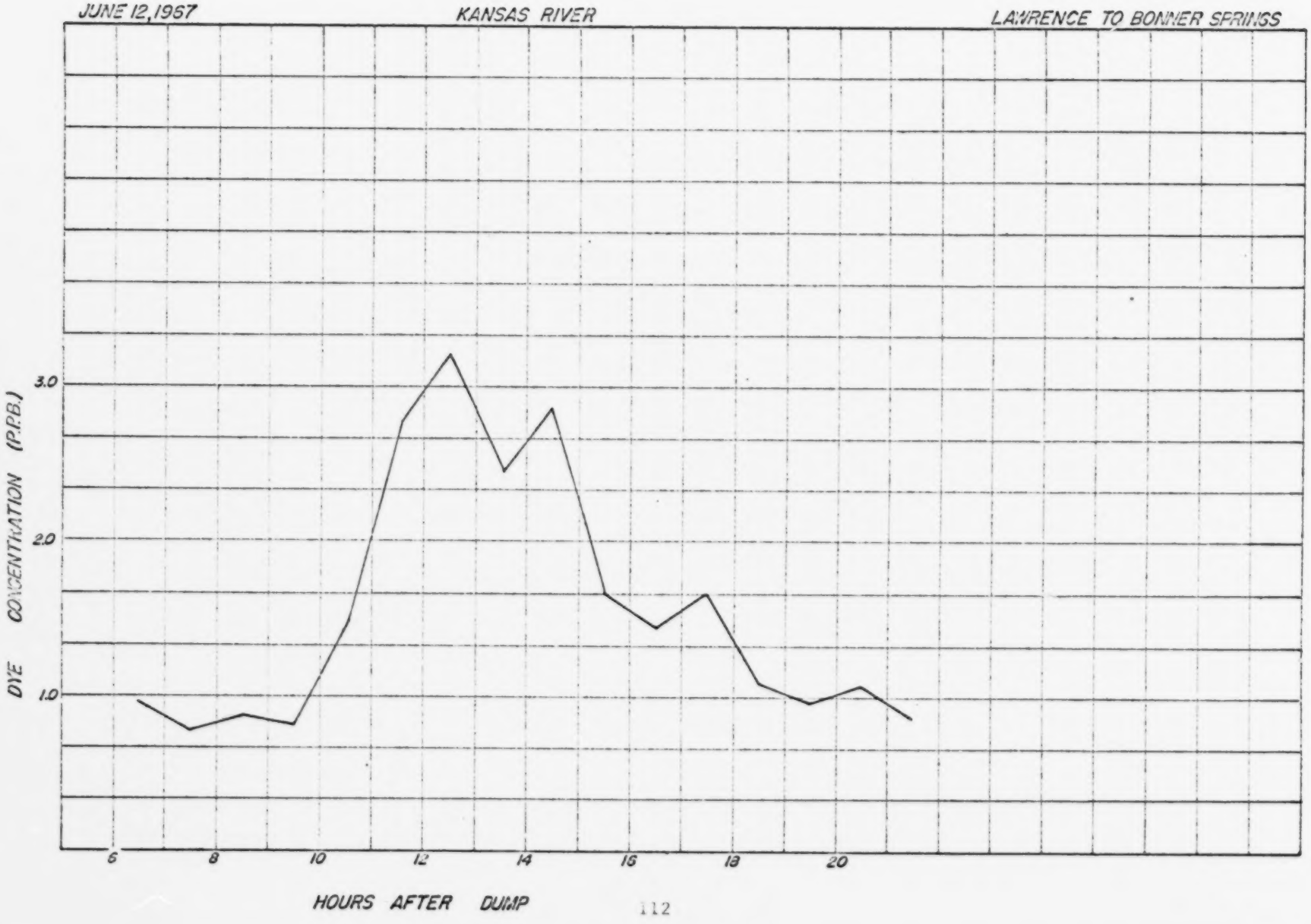

APRIL 26, 1957
KANSAS RIVER
LECOMPTON TO EUDORA
DYE CONCENTRATION (P.P.D.)
4.0
3.0
2.0
1.0
27
28
29
30
31
32
33
34
35
36
37
38
HOURS AFTER DUMP


MARCH 23, 1966
KANSAS RIVER
LAWRENCE TO BONNER SPRINGS
DYE CONCENTRATION (P.P.B.)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
22
23
24
25
26
27
28
29
30
31
32
33
34
HOURS AFTER DUMP


AUG. 11, 1966
KANSAS RIVER
LAWRENCE TO BONNER SPRINGS
DYE CONCENTRATION (P.P.D.)
3.0
2.0
1.0
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
HOURS AFTER DUMP


OCT. 24, 1956
KANSAS RIVER
LAWRENCE TO BONNER SPRINGS
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
25
26
27
28
29
30
31
32
33
34
35
HOURS AFTER DUMP


APRIL 26, 1967
KANSAS RIVER
LAWRENCE TO BONNER SPRINGS
DYE CONCENTRATION (P.P.B.)
4.0
3.0
2.0
1.0
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
HOURS AFTER DUMP

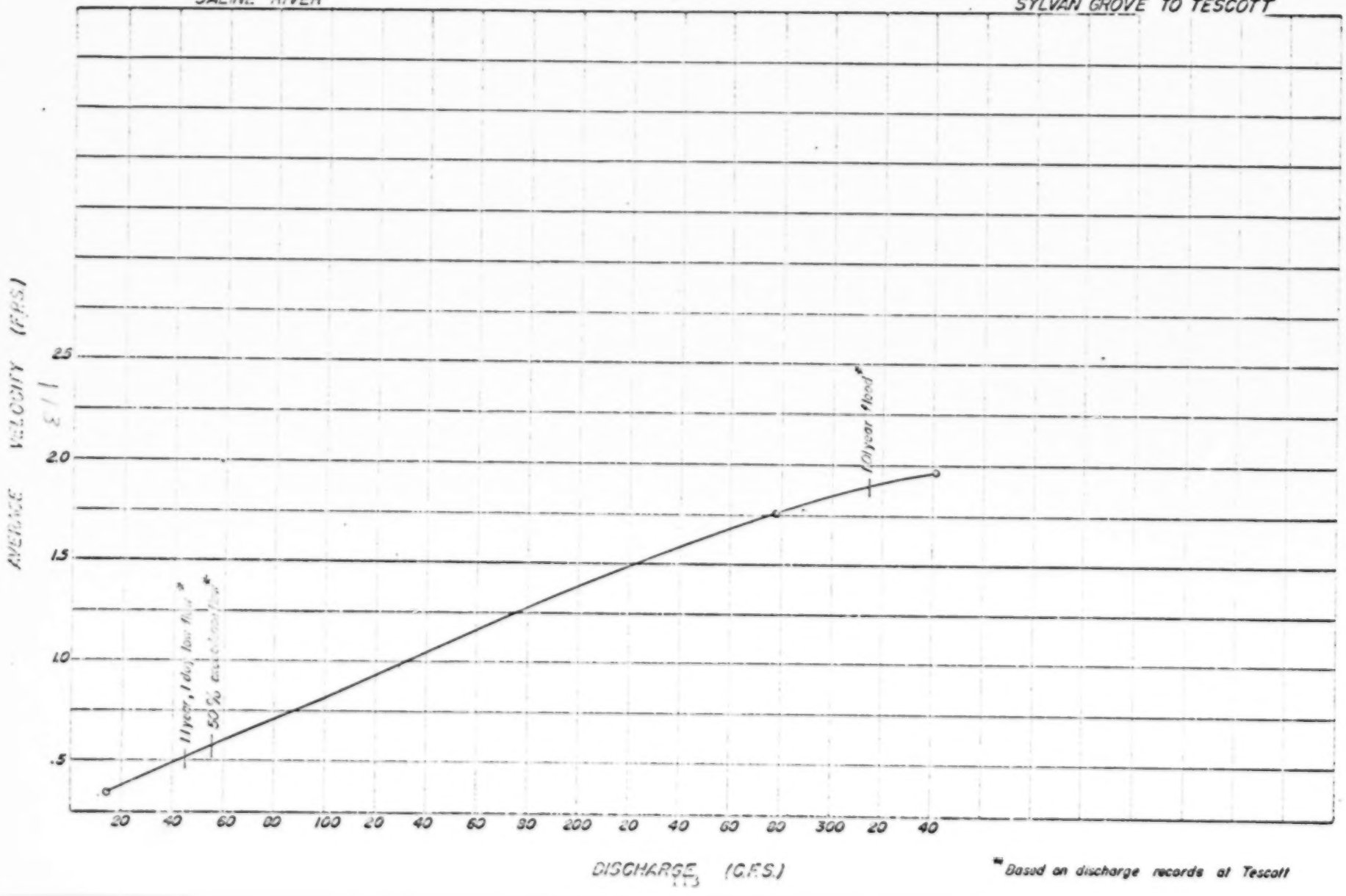

JUNE 12, 1967
KANSAS RIVER
LAWRENCE TO BONNER SPRINGS
DYE CONCENTRATION (P.P.B.)
3.0
2.0
1.0
6
8
10
12
14
16
18
20
HOURS AFTER DUMP

DISCHARGE - VELOCITY CORRELATION CURVES

KANSAS RIVER SURVEY

SALINE RIVER

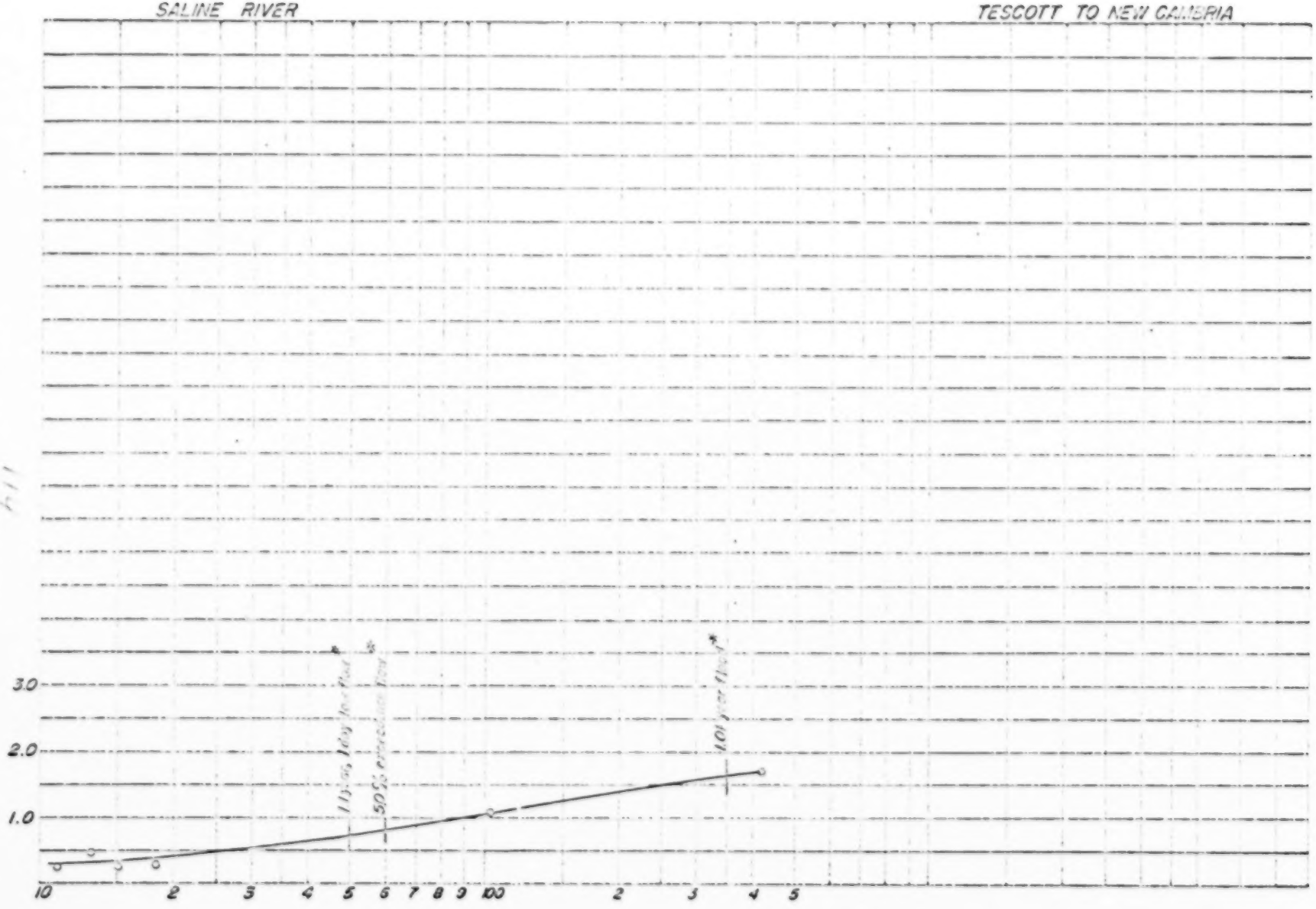
SYLVAN GROVE TO TESCOTT



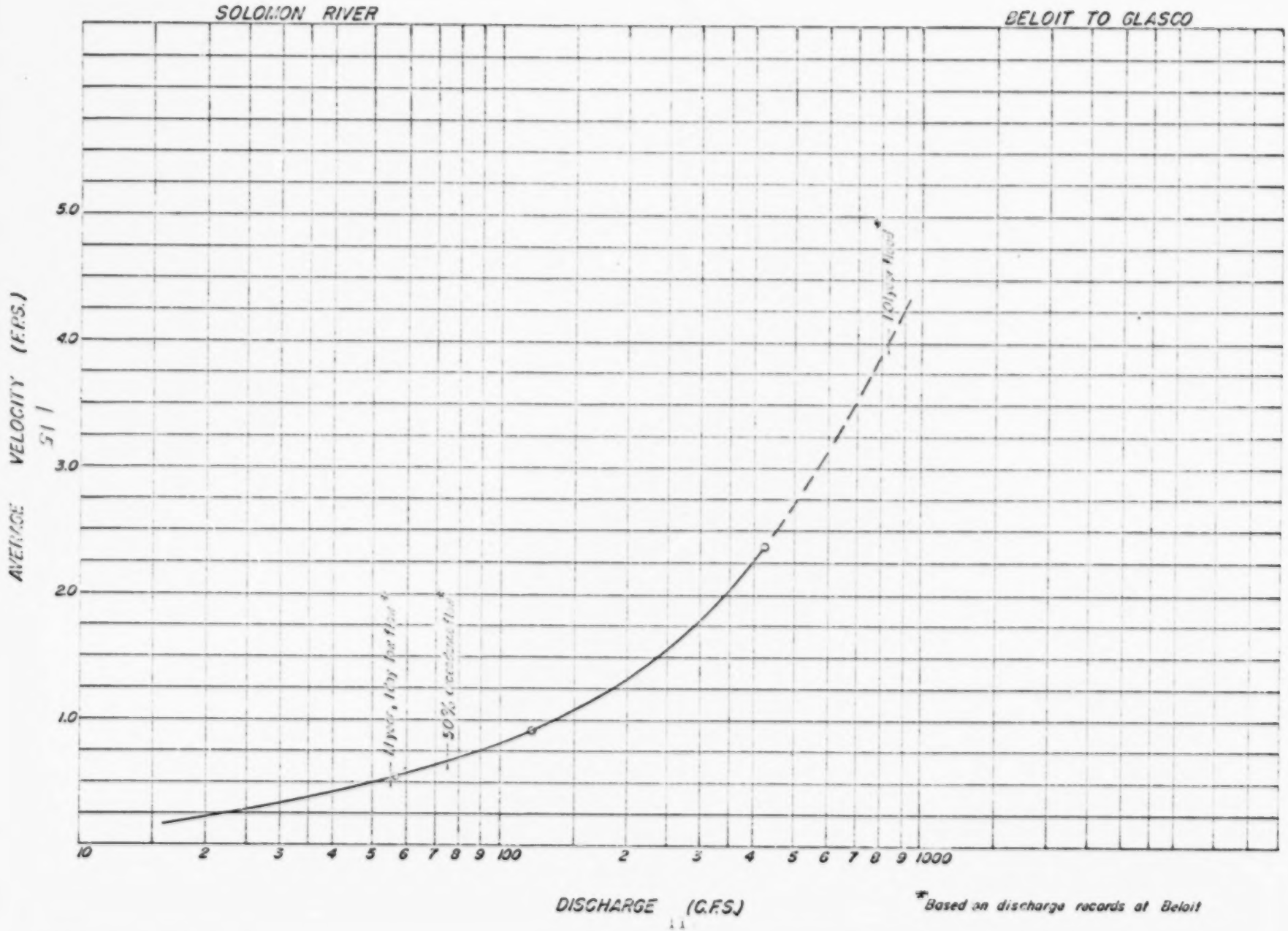
* Based on discharge records at Tescott

SALINE RIVER

TESCOTT TO NEW GALILEIA

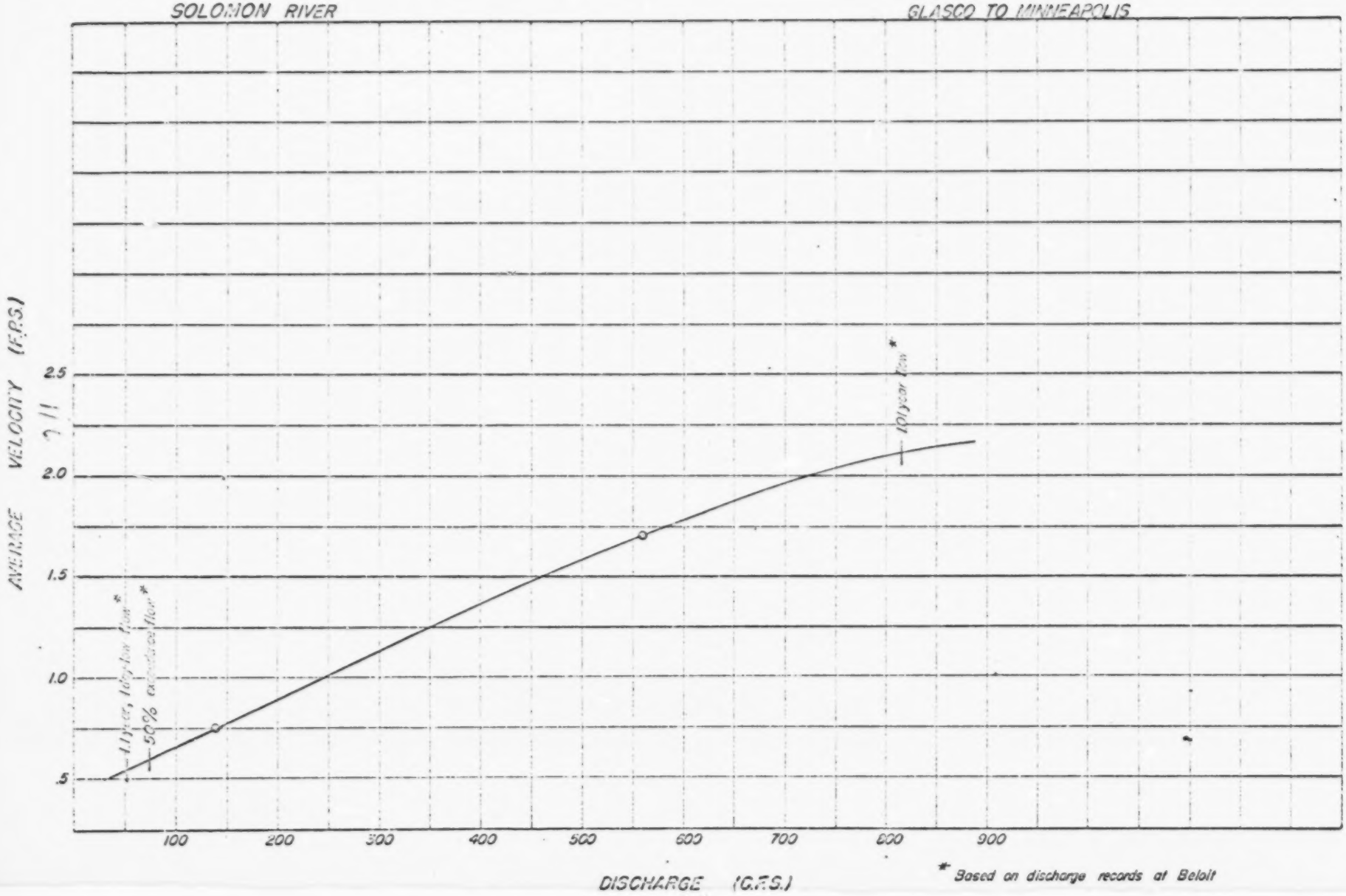


* Based on discharge records at Tescott

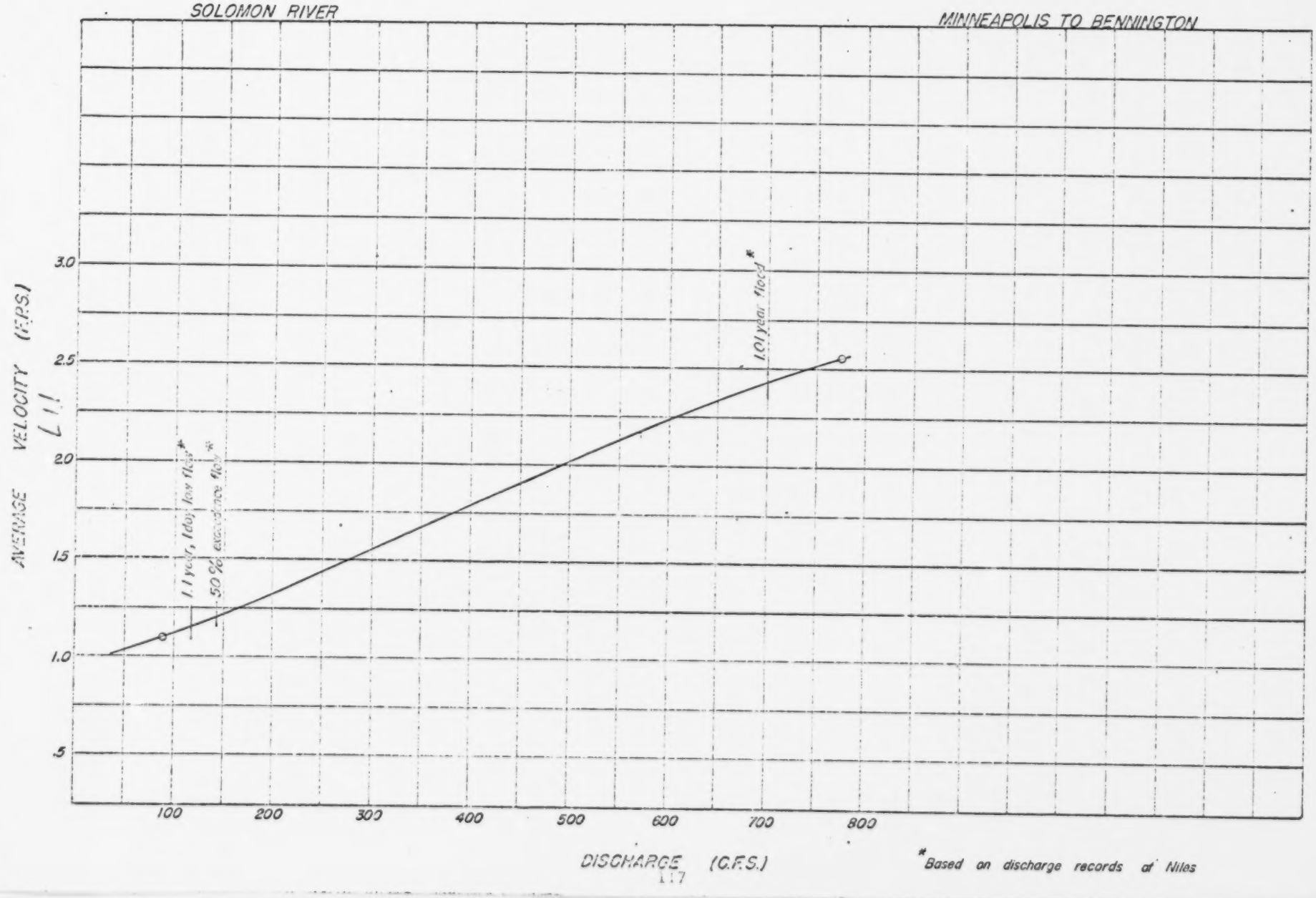

SOLOMON RIVER
BELOIT TO GLASCO
AVERAGE VELOCITY (F.P.S.)
5.0
4.0
3.0
2.0
1.0
10
2
3
4
5
6
7
8
9
100
2
3
4
5
6
7
8
9
1000
DISCHARGE (C.F.S.)
*Based on discharge records at Beloit

SOLOMON RIVER

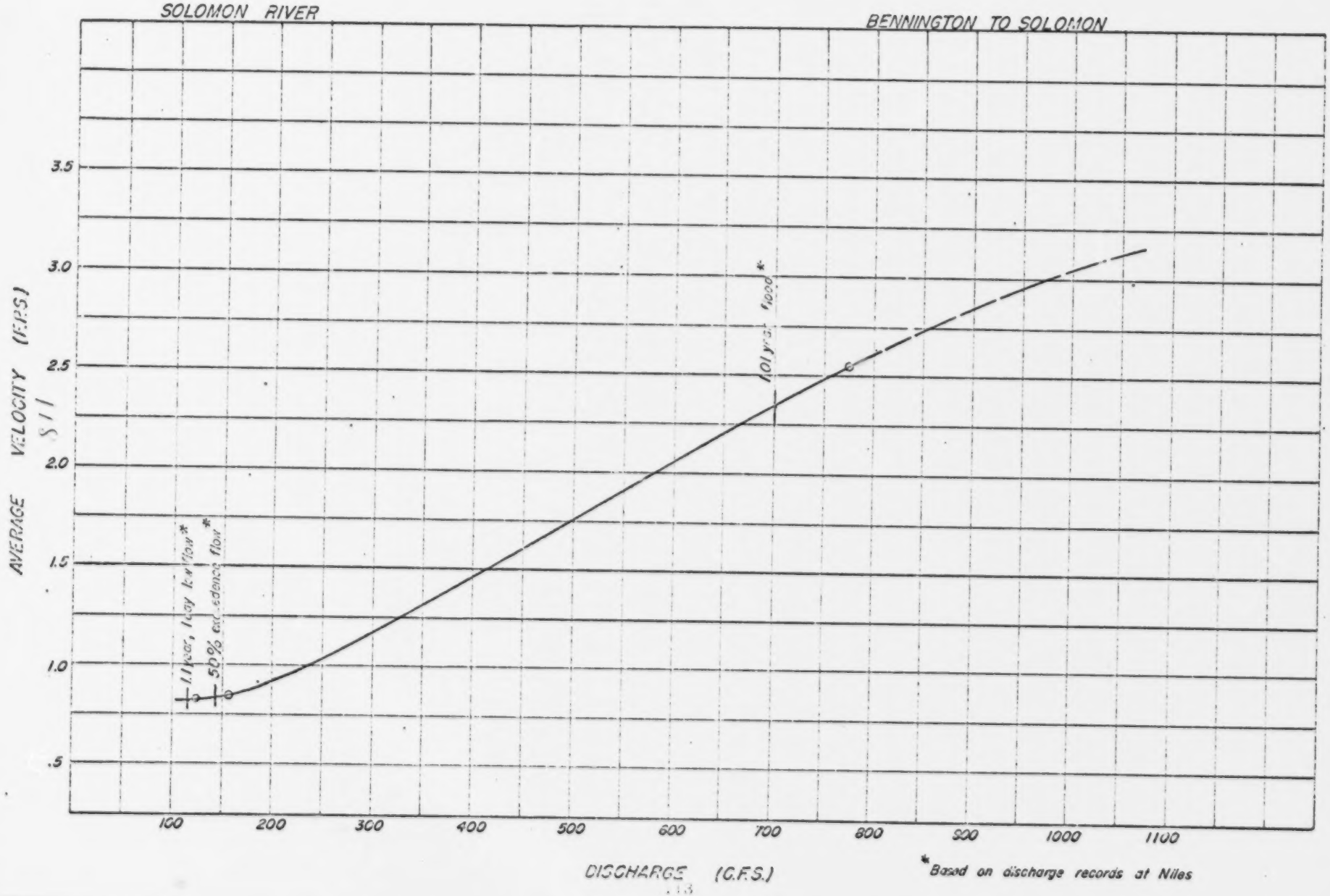
GLASCO TO MINNEAPOLIS

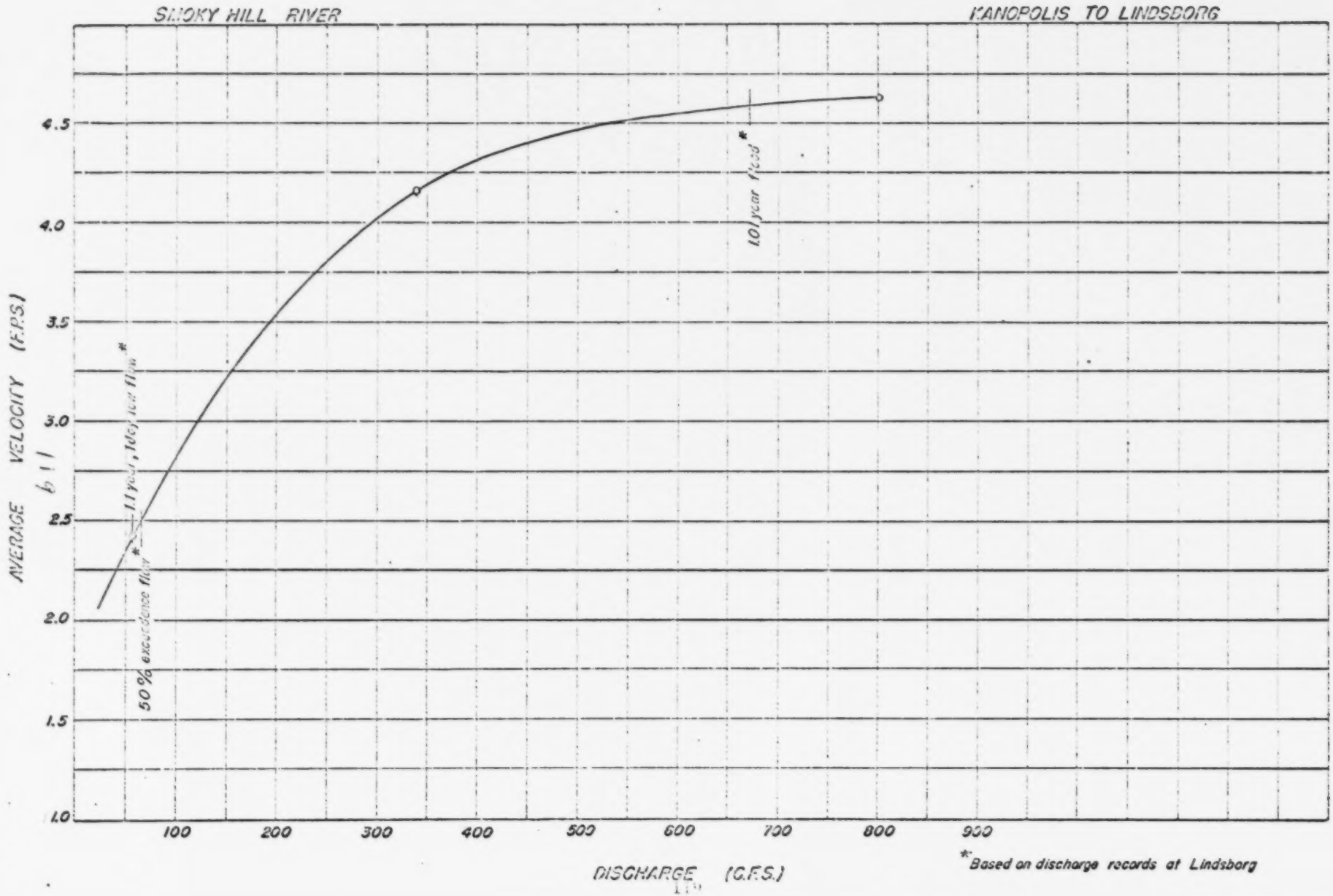


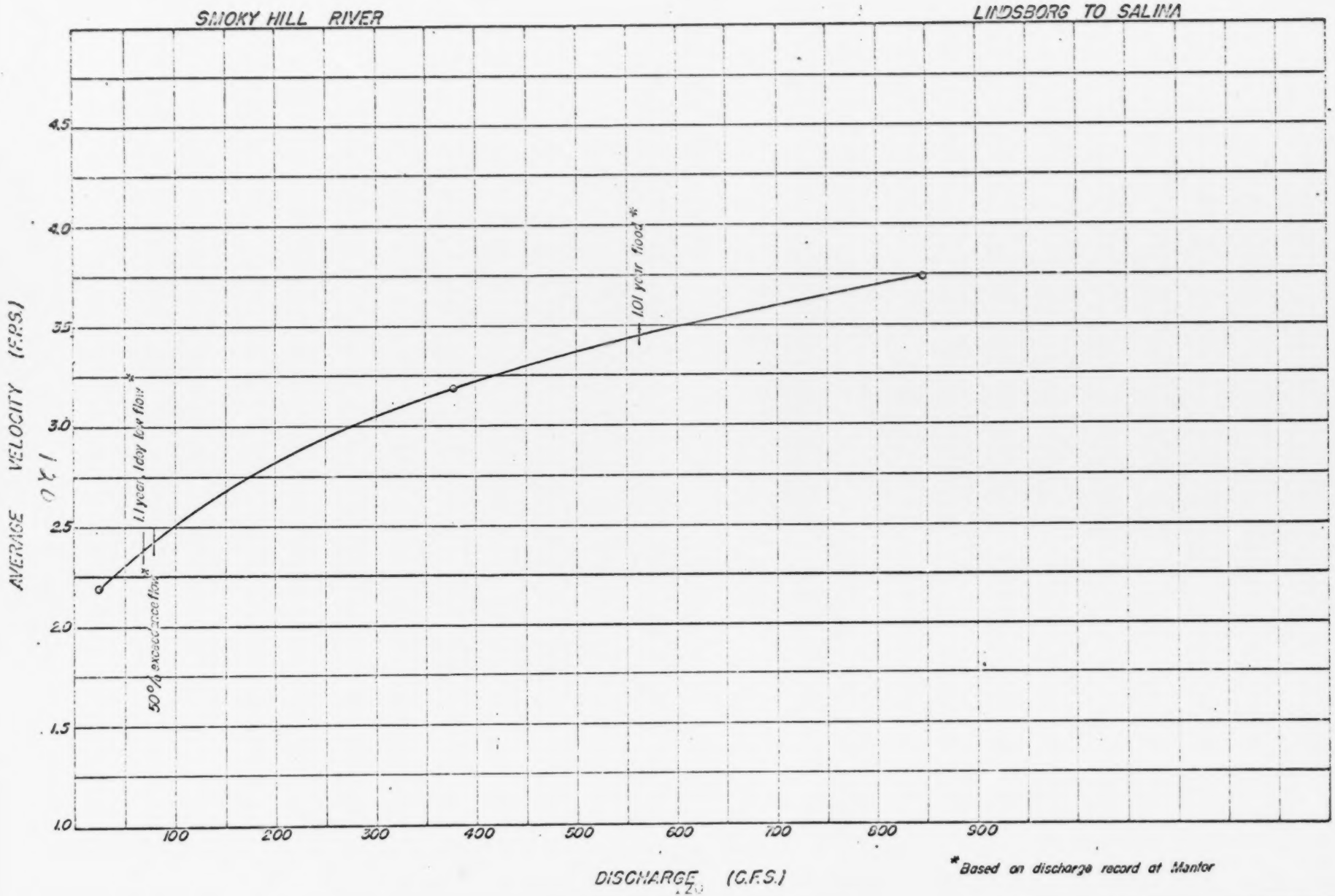
* Based on discharge records at Beloit

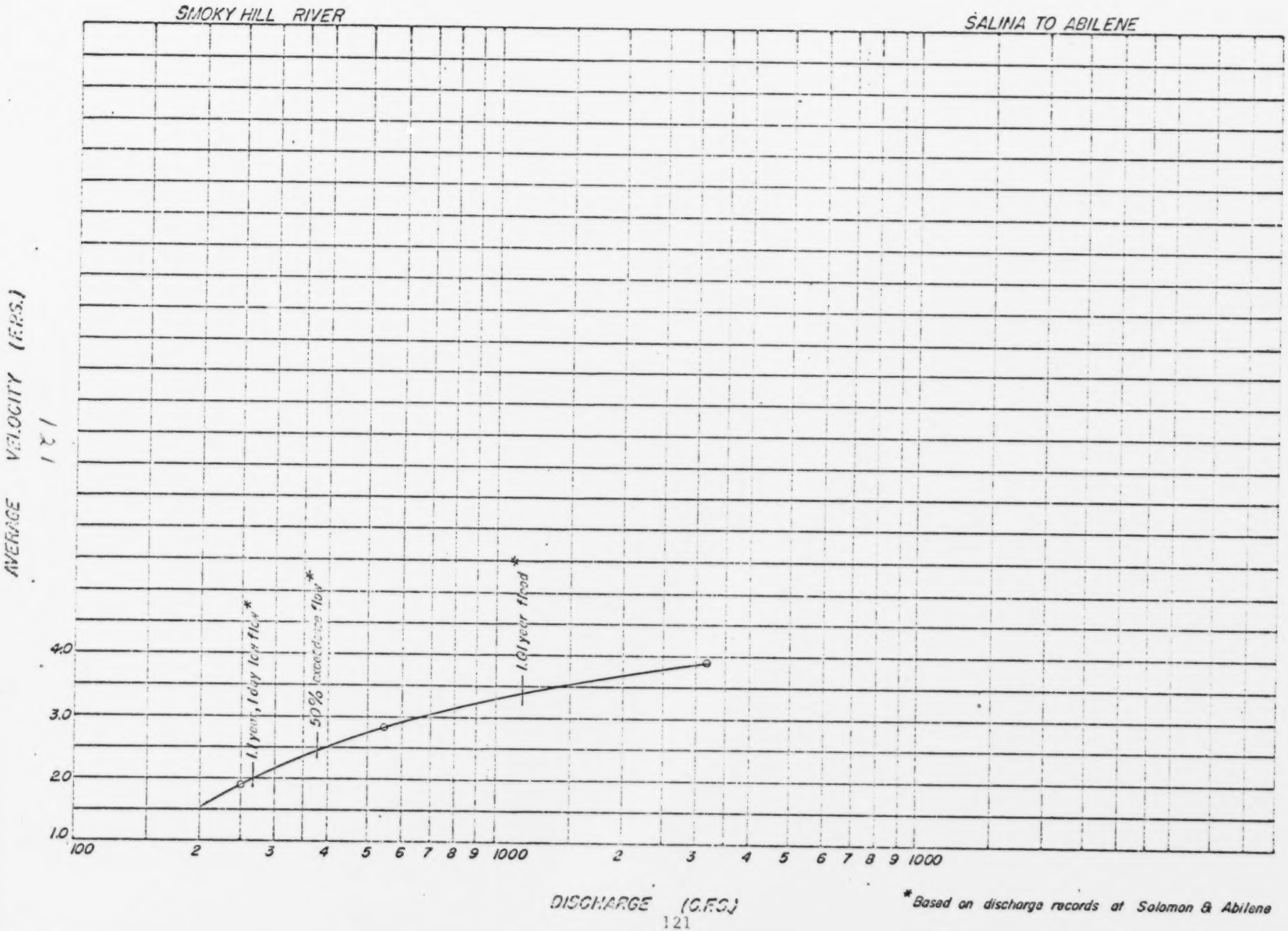

SOLOMON RIVER
MINNEAPOLIS TO BENNINGTON
AVERAGE VELOCITY (F.P.S.)
3.0
2.5
2.0
1.5
1.0
.5
100
200
300
400
500
600
700
800
DISCHARGE (C.F.S.)
1.1 year, 1 day low flow*
50 % exceedance flow*
101 year flood*
*Based on discharge records at Niles

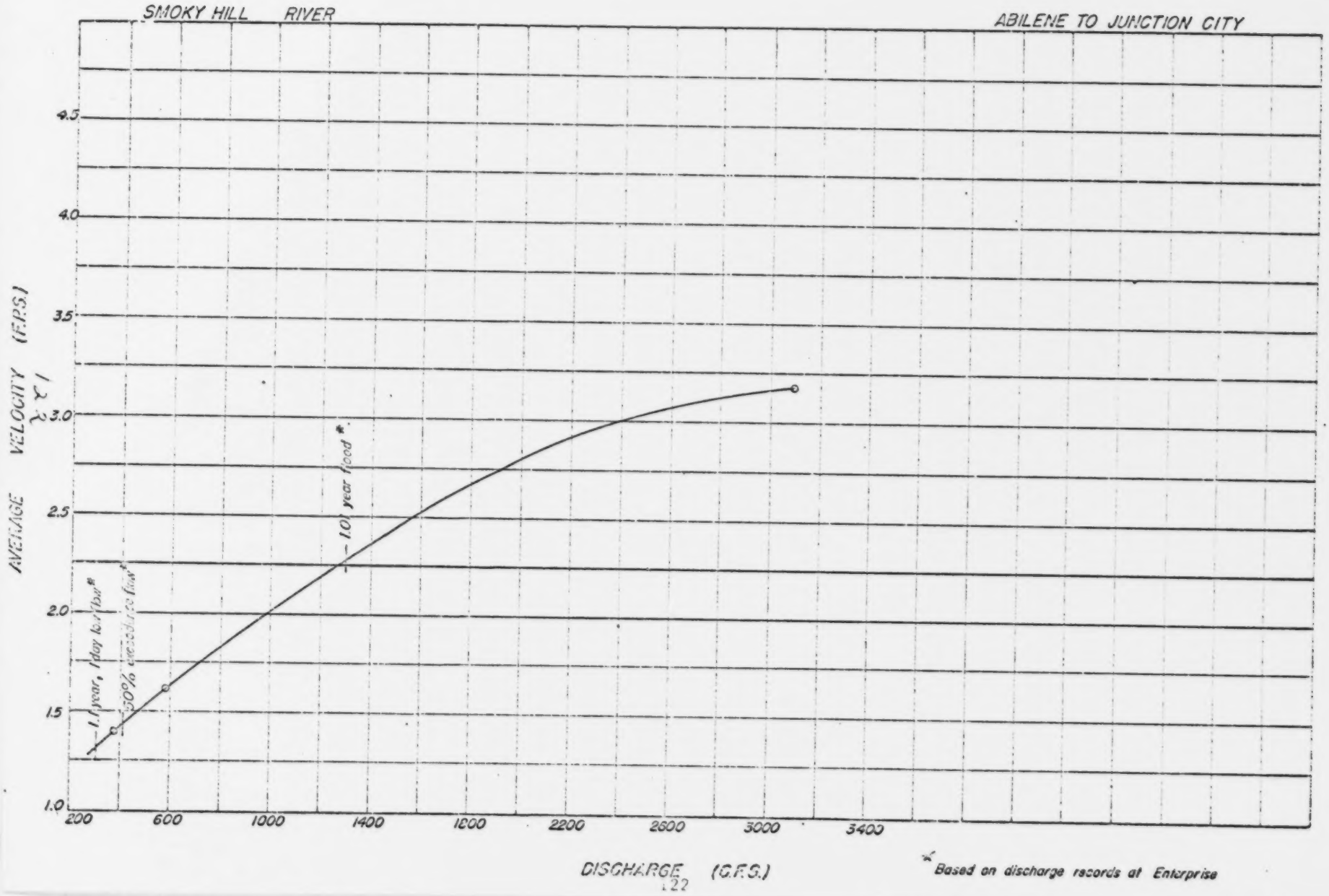
L 11

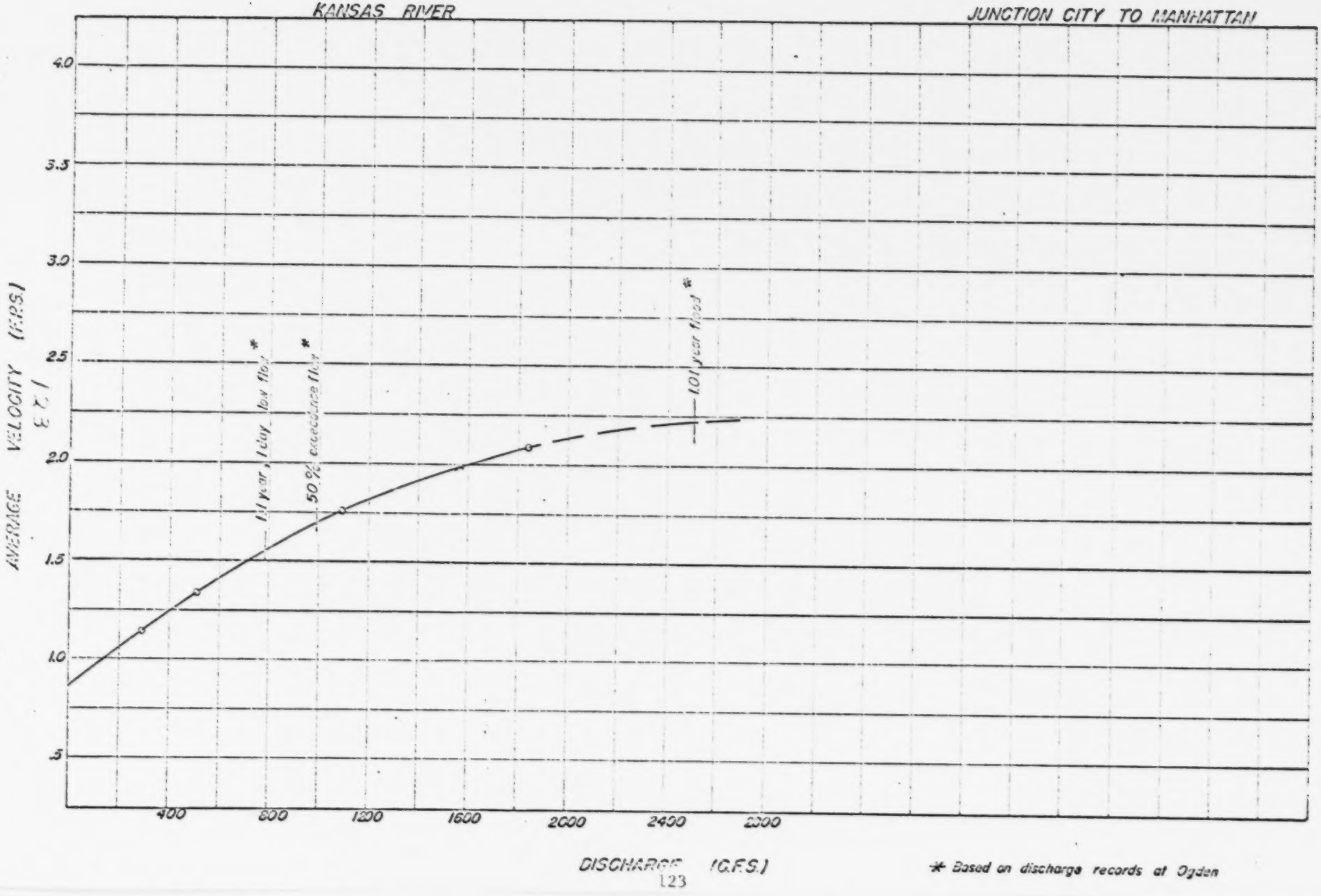

SOLOMON RIVER
BENNINGTON TO SOLOMON
AVERAGE VELOCITY (F.P.S.)
3.5
3.0
2.5
2.0
1.5
1.0
.5
100
200
300
400
500
600
700
800
900
1000
1100
DISCHARGE (C.F.S.)
1.1 year, 1 day low flow*
50% exceedence flow*
101 year flood*
*Based on discharge records at Niles

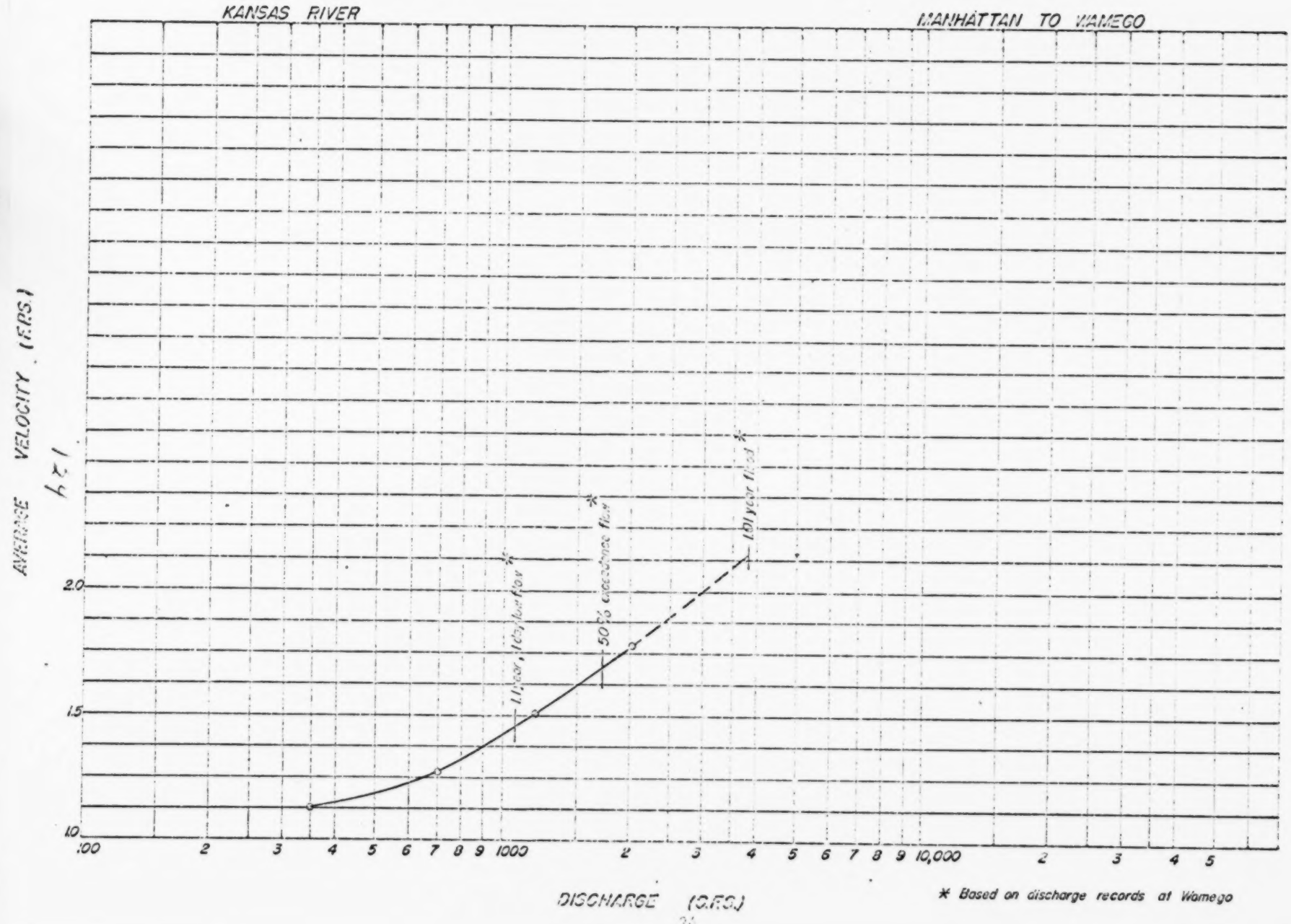

SMOKY HILL RIVER
KANOPOLIS TO LINDSBORG
AVERAGE VELOCITY (F.P.S.)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
100
200
300
400
500
600
700
800
900
DISCHARGE (C.F.S.)
50% exceedence flow*
10 year flow*
*Based on discharge records at Lindsborg

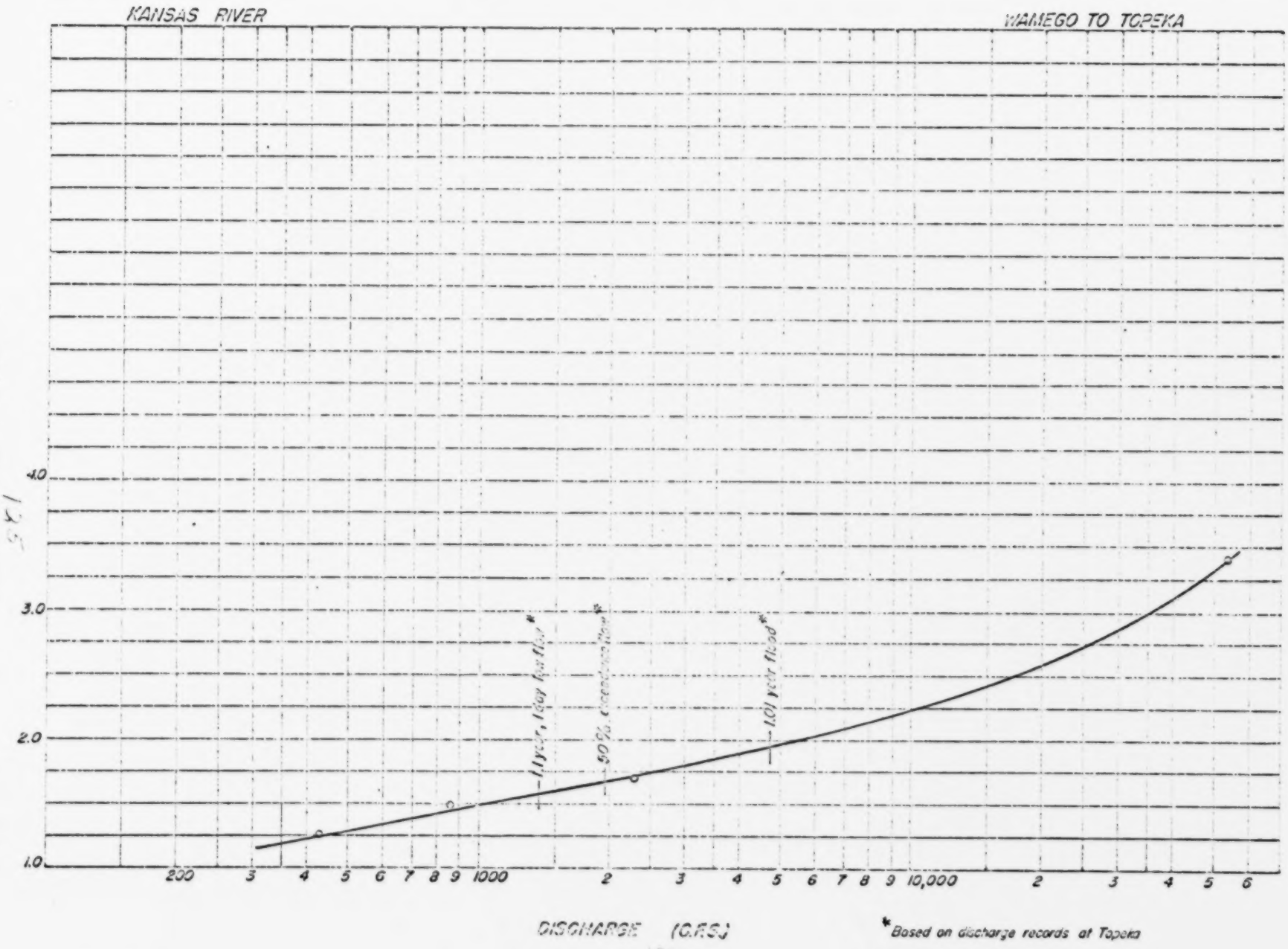

SMOKY HILL RIVER
LINDSBORG TO SALINA
AVERAGE VELOCITY (F.P.S.)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
100
200
300
400
500
600
700
800
900
DISCHARGE (C.F.S.)
1.1 year, 1 day low flow*
50% exceedance flow*
101 year flood*
*Based on discharge record at Mantor

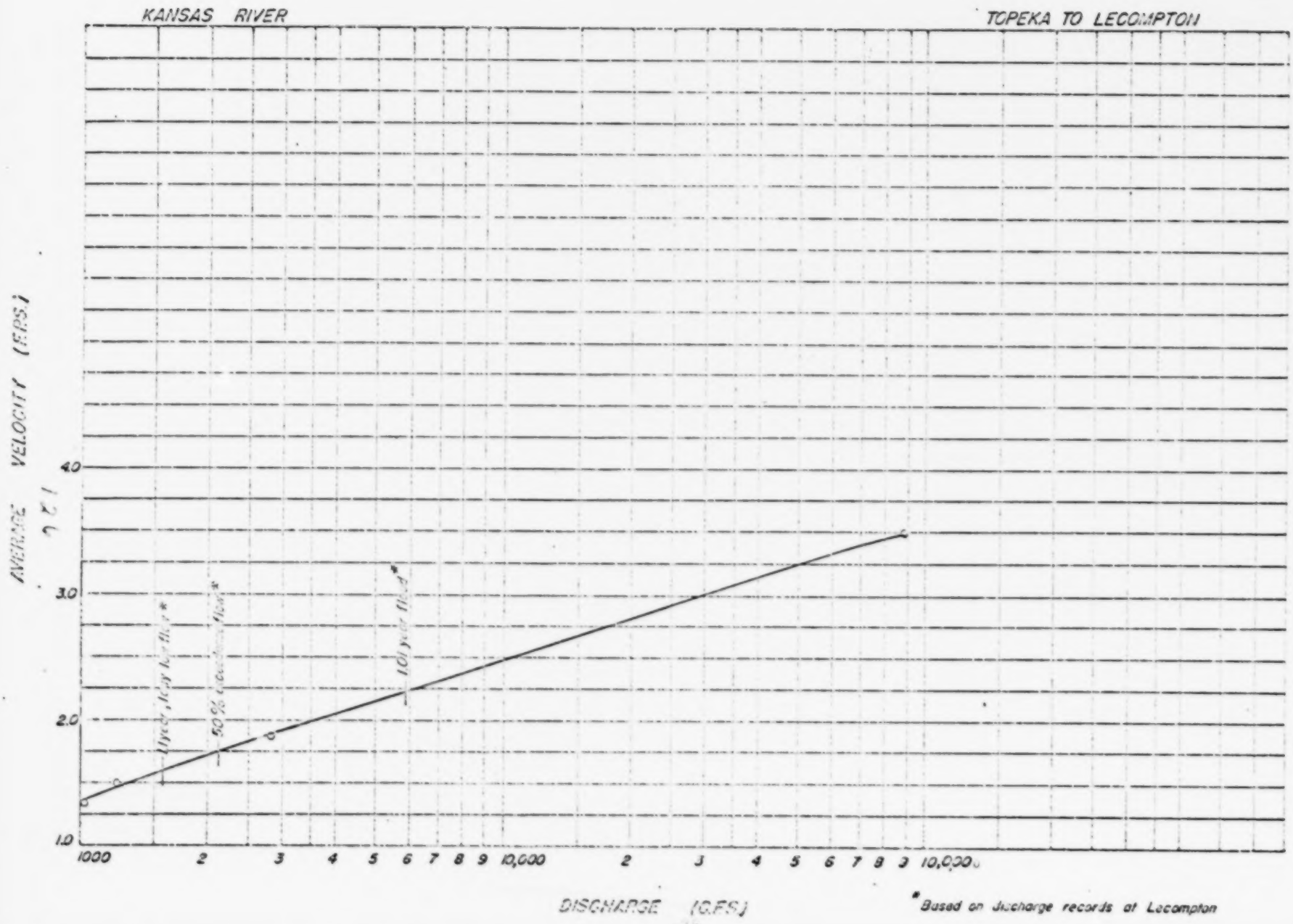

SIMOKY HILL RIVER
SALINA TO ABILENE
AVERAGE VELOCITY (F.P.S.)
4.0
3.0
2.0
1.0
100
2
3
4
5
6
7
8
9
1000
2
3
4
5
6
7
8
9
1000
1.1 year, 1 day low flow*
50% exceedance flow*
1.01 year flood*
DISCHARGE (C.F.S.)
*Based on discharge records at Solomon & Abilene

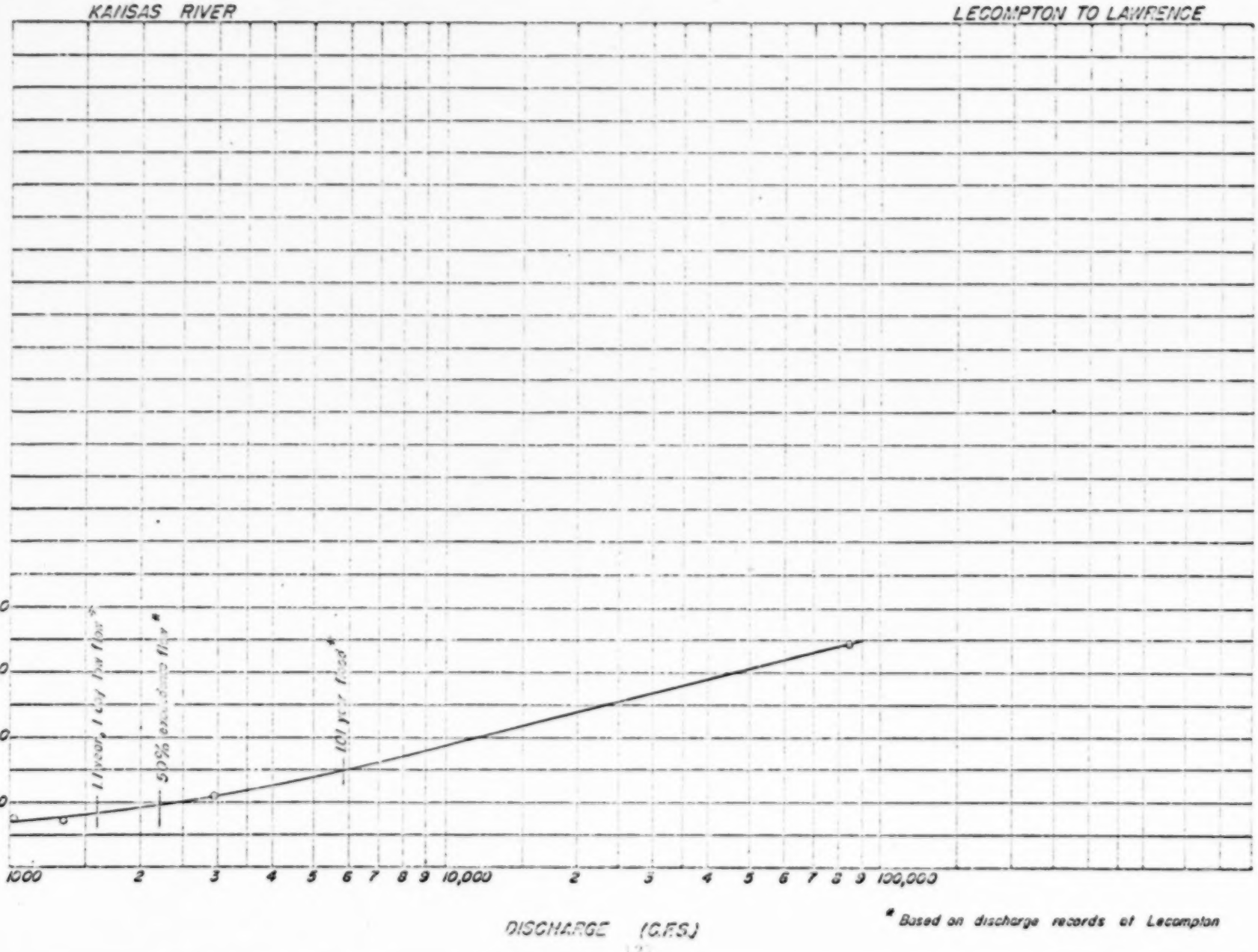

SMOKY HILL RIVER
ABILENE TO JUNCTION CITY
AVERAGE VELOCITY (F.P.S.)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
200
600
1000
1400
1800
2200
2600
3000
3400
DISCHARGE (C.F.S.)
1.01 year flood*
1.1 year, 1 day to 1 year*
50% exceedance flow*
* Based on discharge records at Enterprise

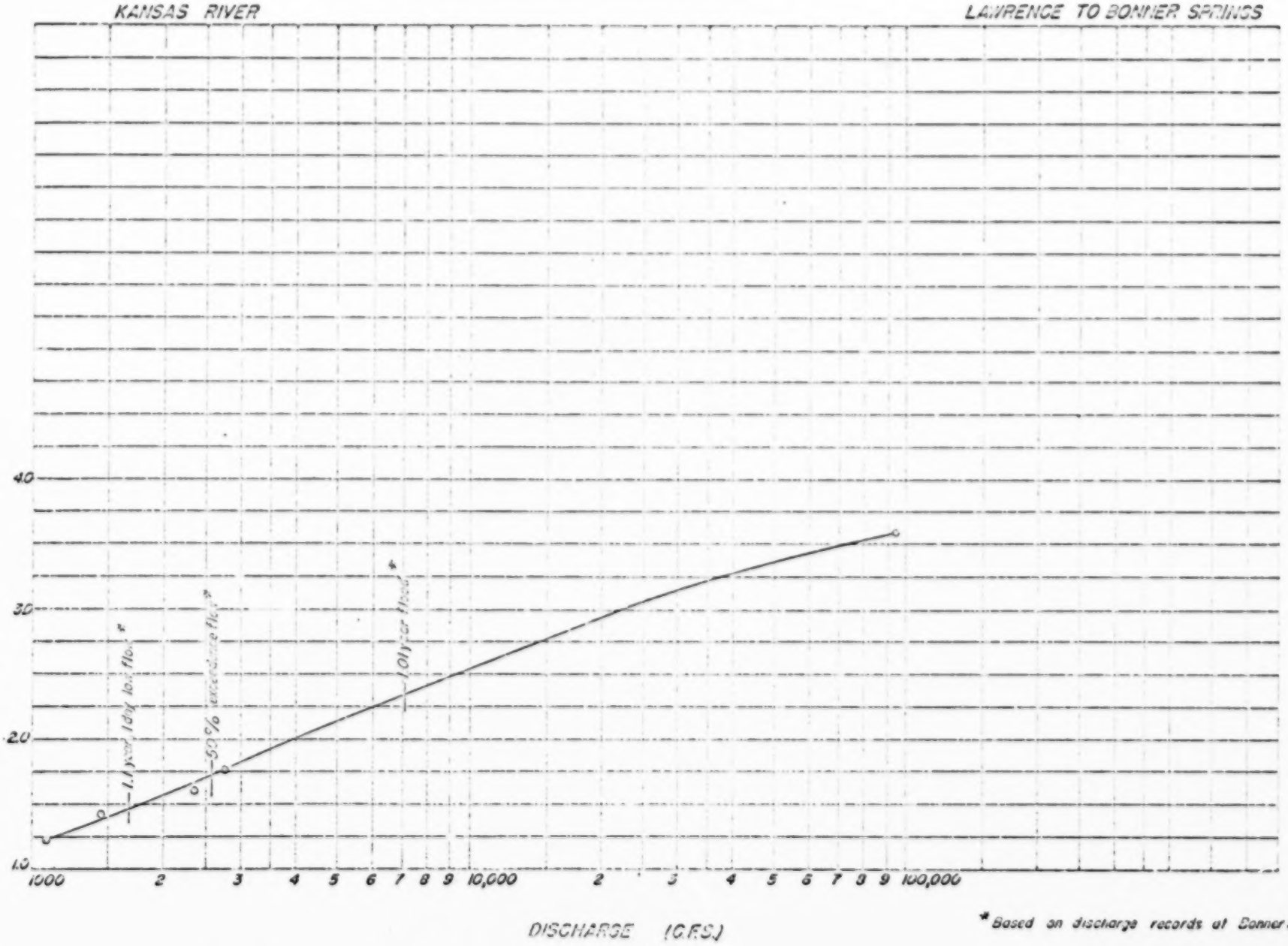

KANSAS RIVER
JUNCTION CITY TO MANHATTAN
AVERAGE VELOCITY (F.P.S.)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
1.1 year, 1 day low flow *
50% exceedance flow *
10 year flood *
400
800
1200
1600
2000
2400
2800
DISCHARGE (C.F.S.)
* Based on discharge records at Ogden


KANSAS RIVER
MANHATTAN TO WAMEGO
AVERAGE VELOCITY (F.P.S.)
4 2 1
2.0
1.5
1.0
.00
2
3
4
5
6
7
8
9
1000
2
3
4
5
6
7
8
9
10,000
2
3
4
5
1.1 year, 1 day flow *
50% exceedance flow *
101 year flood *
DISCHARGE (C.F.S.)
* Based on discharge records at Wamego


KANSAS RIVER
WAMEGO TO TOPEKA
AVERAGE VELOCITY (F.P.S.)
4.0
3.0
2.0
1.0
200
3
4
5
6
7
8
9
1000
2
3
4
5
6
7
8
9
10,000
2
3
4
5
6
DISCHARGE (C.F.S.)
1-Year, 1-day flood*
50% exceedance flow*
10-Year flood*
*Based on discharge records at Topeka


KANSAS RIVER
TOPEKA TO LECOMPTON
AVERAGE VELOCITY (F.P.S.)
4.0
3.0
2.0
1.0
1000
2
3
4
5
6
7
8
9
10,000
2
3
4
5
6
7
8
9
10,000
DISCHARGE (C.F.S.)
* Based on discharge records at Lecompton


KANSAS RIVER
LECOMPTON TO LAWRENCE
AVERAGE VELOCITY (F.P.S.)
40
30
20
10
1000
2
3
4
5
6
7
8
9
10,000
2
3
4
5
6
7
8
9
100,000
DISCHARGE (C.F.S.)
1 year 1 day flow*
50% exceedance flow*
10 year flood*
* Based on discharge records at Lecompton

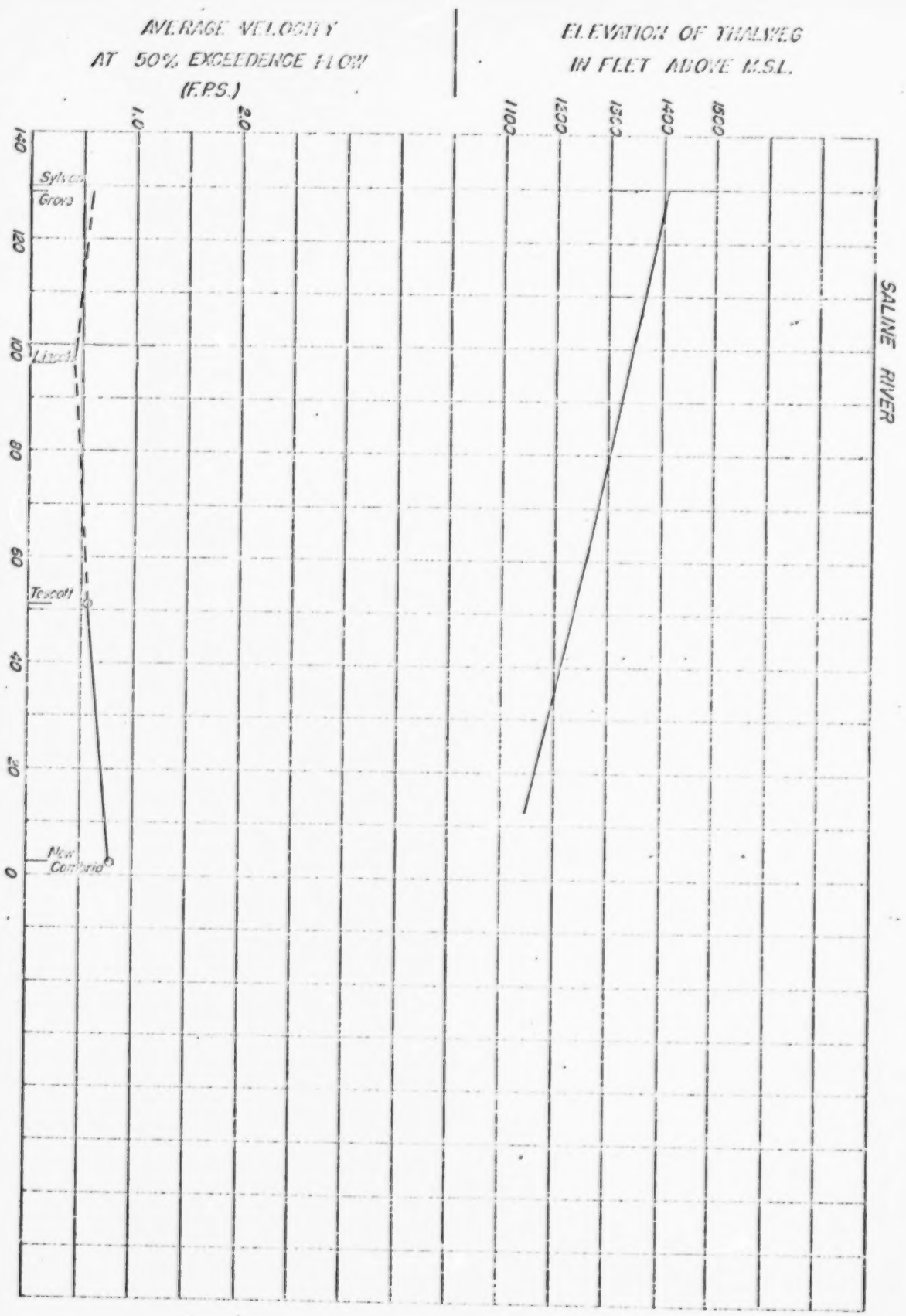


* Based on discharge records at Bonner Springs

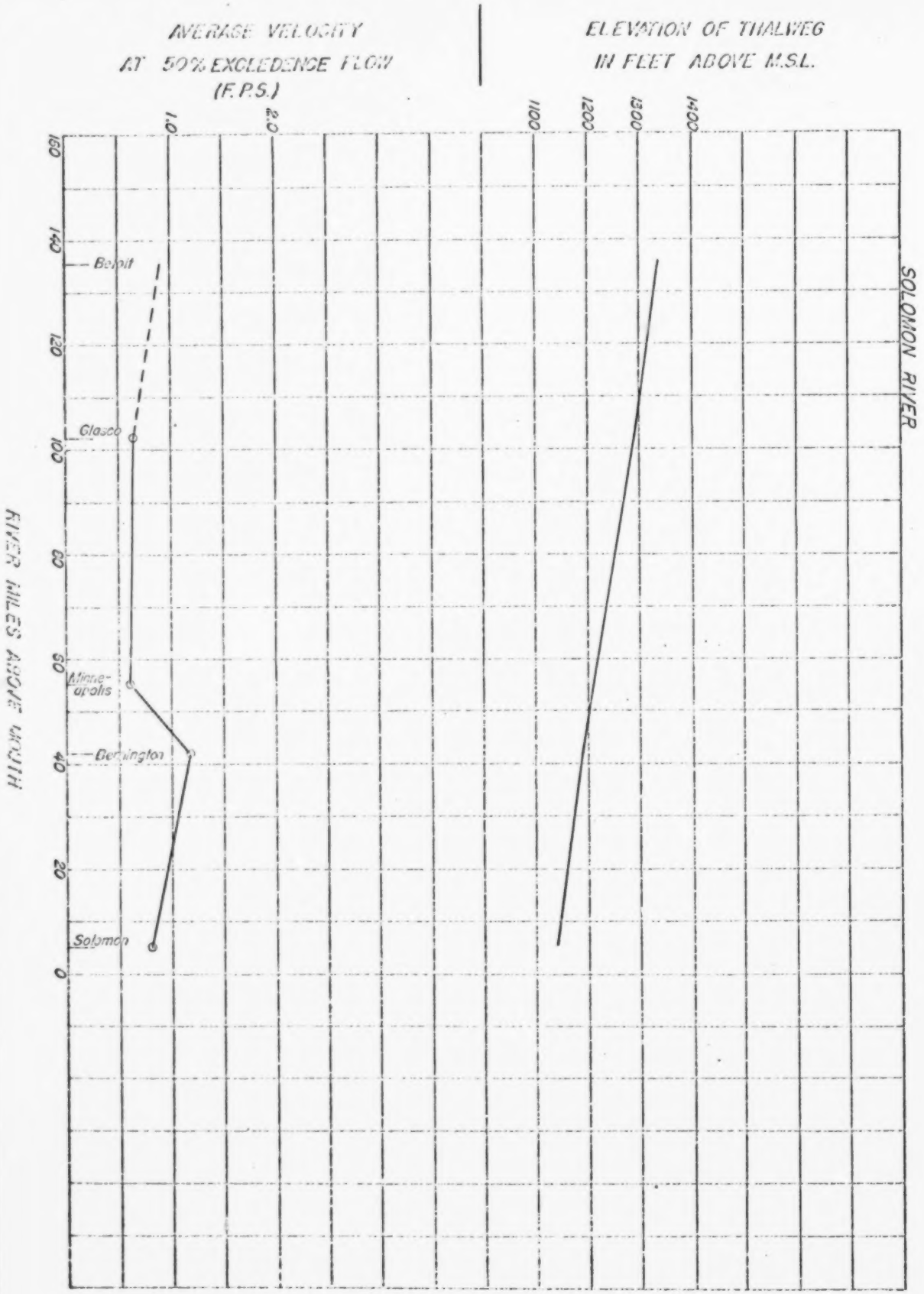
VELOCITY - RIVER MILEAGE CURVES

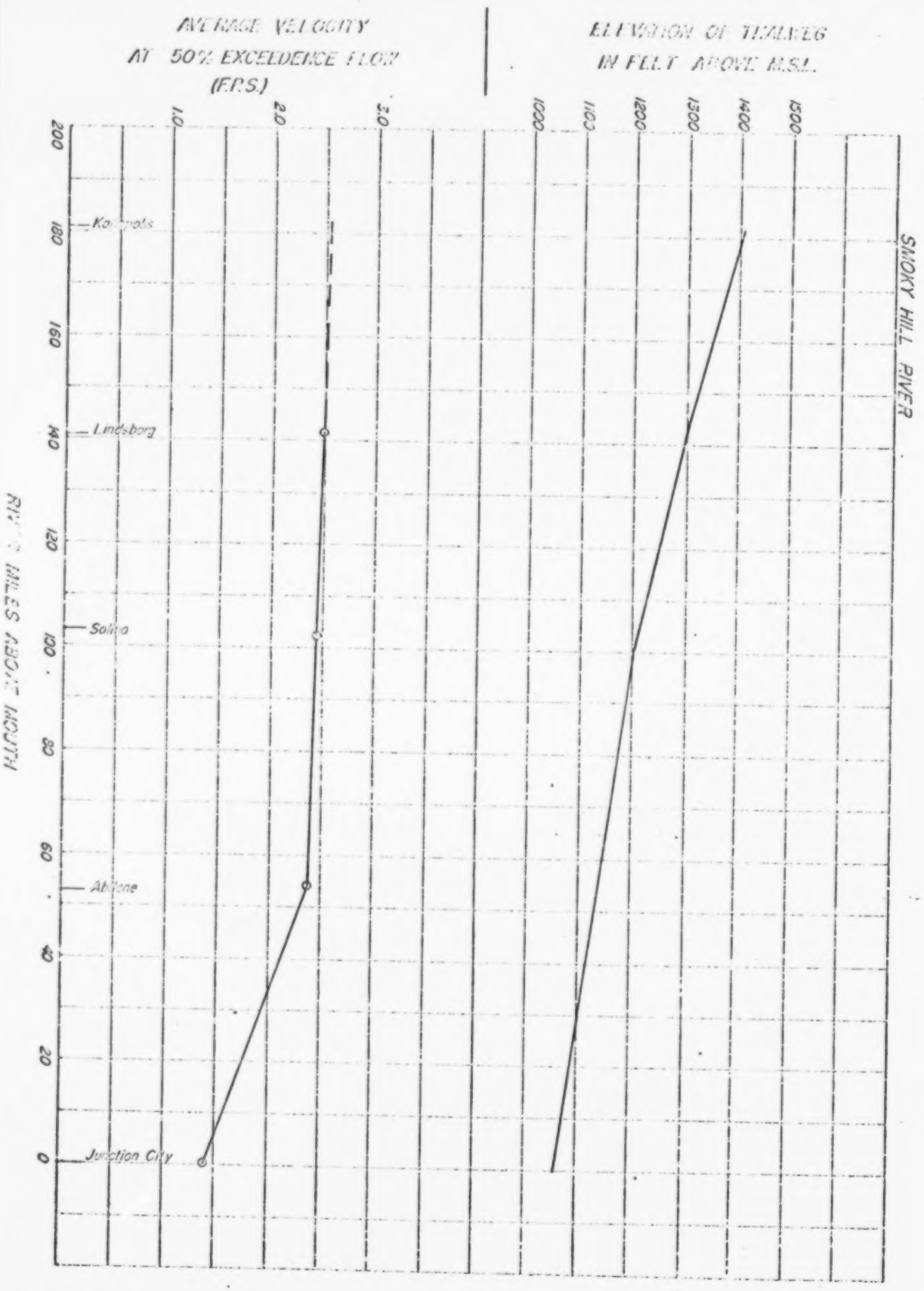
KANSAS RIVER SURVEY

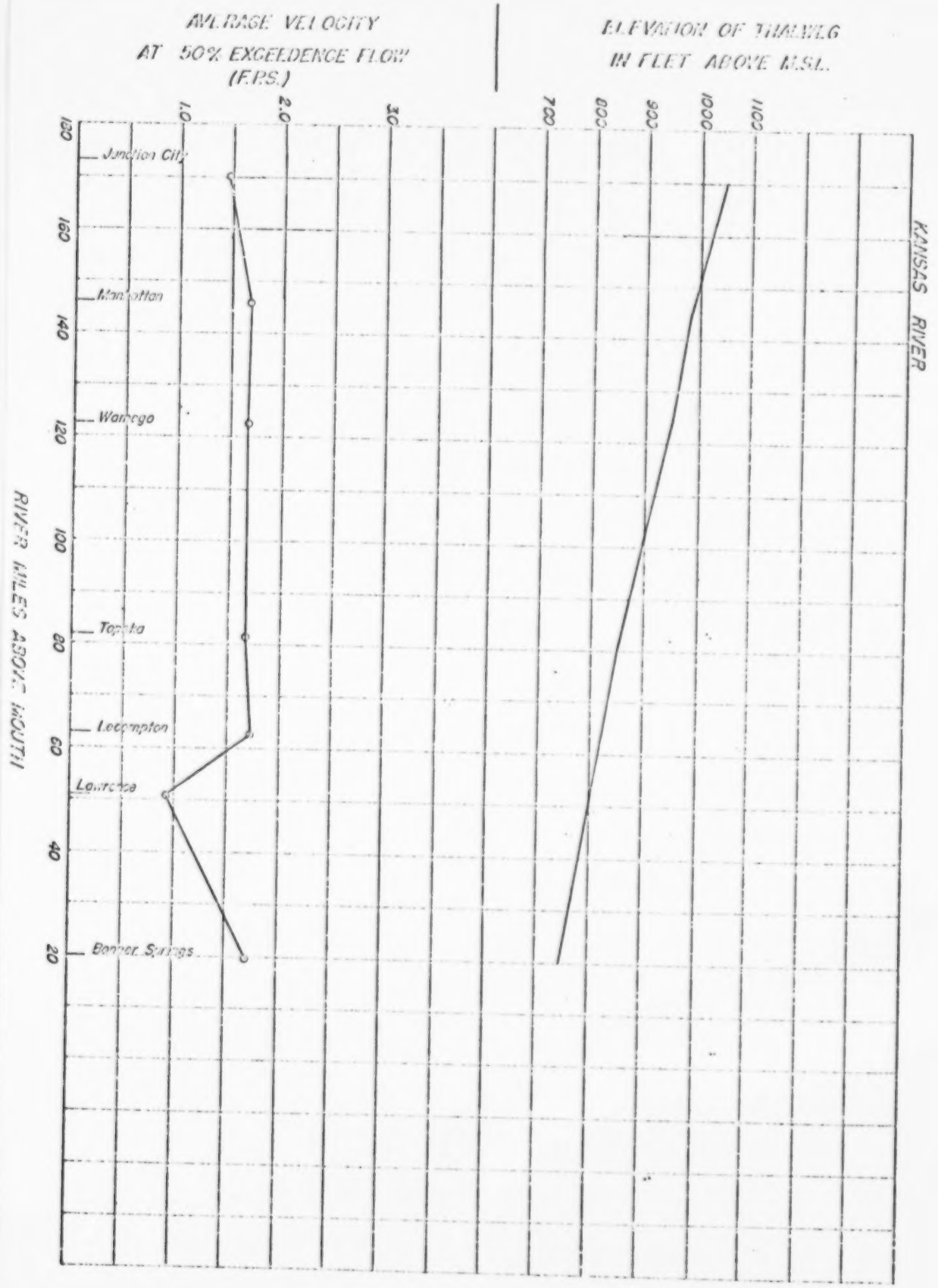
1252



RIVER MILES ABOVE MOUTH


AVERAGE VELOCITY
AT 50% EXCEEDENCE FLOW
(F.P.S.)
ELEVATION OF THALWEG
IN FEET ABOVE M.S.L.
1.0
2.0
1100
1200
1300
1400
160
140
120
100
80
60
40
20
0
Beloit
Glasco
Minne-
apolis
Bennington
Solomon
SOLOMON RIVER
RIVER MILES ABOVE MOUTH


AVERAGE VELOCITY
AT 50% EXCEEDENCE FLOW
(F.P.S.)
ELEVATION OF TRAVEL
IN FEET ABOVE M.S.L.
SMOKY HILL RIVER
RIVER MILES ABOVE MOUTH
Kanopolis
Lindsborg
Salina
Abilene
Junction City
0
20
40
60
80
100
120
140
160
180
200
1.0
2.0
3.0
1000
1100
1200
1300
1400
1500


AVERAGE VELOCITY
AT 50% EXCEEDENCE FLOW
(F.P.S.)
ELEVATION OF THALWEG
IN FEET ABOVE M.S.L.
1.0
2.0
3.0
700
800
900
1000
1100
160
140
120
100
80
60
40
20
Junction City
Manhattan
Wamego
Topeka
Lecompton
Lawrence
Bonner Springs
KANSAS RIVER
RIVER MILES ABOVE MOUTH

APPENDIX

TABLE II

DISCHARGE MEASUREMENTS CORRESPONDING TO SAMPLE ANALYSIS

The following table contains instantaneous discharge figures in cubic feet per second based on gage height readings taken at the time of sampling. The figures are preliminary, subject to change due to rating table shift. Data from U. S. Geological Survey and U. S. Army Corps of Engineers

	Date									
Station No.	June 13 1966	June 20 1966	June 27 1966	July 5 1966	July 11 1966	July 18 1966	July 25 1966	August 1 1966	August 8 1966	August 15 1966
K-2	36,000	2,600	17,000	2,100	2,600	2,100	2,300	2,100	1,800	1,800
K-5	35,000	1,700	13,000	1,700	1,900	1,300	1,750	1,650	1,800	1,800
K-7	2,800	2,900	1,300	1,500	1,400	800	1,450	1,150	1,700	1,700
K-8	1,500	2,400	1,400	1,500	1,500	1,100	1,500	1,200	1,800	1,200
B-9	150	1,000	200	800	800	200	900	25	300	100
R-11	225	300	250	375	400	350	600	1,000	500	400
SH-13	550	800	155	150	75	65	700	700	700	400
SH-14	250	675	160	155	130	125	700	700	600	300
SO-16	90	80	65	65	30	40	50	135	60	45
SO-18	5	1.5	25	6	2	0.1 est	2	3	.2 est	3
SA-19	13	7.0	5	8	6	5	16	16	8	30
SH-21	100	640	75	60	50	25	45	780	550	230
SH-22	275	475	85	80	65	50	155	850	700	150

TABLE II - Cont.

Station No.	Date									
	August 22 1966	August 29 1966	Sept. 12 1966	Sept. 19 1966	Oct. 3 1966	Oct. 17 1966	Oct. 31 1966	Nov. 14 1966	Nov. 28 1966	Dec. 12 1966
K-2	2,000	3,400	2,00	2,200	2,800	4,200	820	1,280	2,550	1,150
K-5	3,300	2,900	2,190	2,610		2,500	1,400	1,350	1,900	1,000
K-7	3,000	2,600	2,100	2,200	2,600	2,500	1,850	2,120	1,200	800
K-8	2,500	2,100	2,400	2,700	2,400	1,400	2,100	1,200	1,780	470
B-9	800	12	800	1,500	1,800	100	1,132	958	1,480	225
R-11	700	720	500	550	250	12	350	128	218	15
SH-13	4,500	1,400	578	499		800	150	138	151	110
SH-14	2,500	450	434	220						
SO-16	4,800	180	106	86						
SO-18	220	50	58	62				42	48	44
SA-19	125	25	15	16						
SH-21	475	510	387	180						
SH-22	170	525	390	165	85	1,000	13			13
SA-20								85	92	

TABLE II - Cont.

Station No.	Date									
	Jan. 9 1967	Jan. 23 1967	Febr. 6 1967	Febr. 20 1967	March 13 1967	March 27 1967	April 10 1967	April 24 1967	May 1 1967	May 15 1967
K-2	600	700	900	750	600	650	1,500	1,500	900	900
K-5	575	650	850	750	550	625	1,300	1,000	700	800
K-7	550	500	700	700	500	600	700	600	450	600
K-8	500	425	600	600	450	800	700	525	450	400
B-9	250	225	425	300	50	50	50	50	50	50
R-11	100	37	25	150	200	200	300	100	100	100
SH-13	125	150	150	150	150	200	150	250	250	200
SH-14		50	45	40	50	45	45	110	100	50
SA-15	50									
SO-16	38	100	100	65	60	70	55	60	55	65
SO-18					40	30	30	40	60	50
SH-22	13	15	10	12	17	20	25	100	90	20